# AGRICULTURAL ENGINEERING

Published by the AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS

Executive Office of the Society: Saint Joseph, Michigan.

KARL J. T. EKBLAW, *President* RAYMOND OLNEY, *Secretary-Treasurer*

VOLUME 20 DECEMBER 1939 NUMBER 12


## CONTENTS




**Published monthly by the American Society of Agricultural Engineers. Publication office at Benton Harbor, Michigan. Editorial and advertising departments at the executive office of the Society, St. Joseph, Michigan . . . . Price $3.00 a year, 30 cents a copy; to members $2.00 a year, 20 cents a copy. Postage to countries to which second-class rates do not apply, $1.00 additional . . . . The Society is not responsible for statements and opinions contained in papers published in this journal; they represent the views of the individuals to whom they are credited and are not binding on the Society as a whole . . . . Entered as second-class matter, October 28, 1933, at the post office at Benton Harbor, Michigan, under the Act of August 24, 1912. Additional entry at St. Joseph, Michigan. Acceptance for mailing at the special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized August 11, 1921 . . . .**

# Farm Feed Grinding

AGRICULTURAL engineering service to farmers in the matter of feed grinding awaits new knowledge on physical condition of feeds as a factor in feeding values. A recent survey has shown that in many states feed grinding is not being recommended by the agricultural extension services and is not generally practiced by farmers. Many farmers are reported to see little point in grinding feed unless it is ground fine. Such data as exists, however, points to coarse grinding of feeds as a more desirable and economic practice.

Farm grinders, elevators, separators, mixers, and power units are available in sizes adapted to any scale of operations, and capable of doing an economical job of grinding any of a wide range of grains and forage to any desired degree of fineness.

What are the most desirable degrees and combinations of fineness of feeds to show increased farm profit in meeting market demand for meats, milk, eggs, or wool, in consideration of grinding costs, feed consumption and waste, market quality premiums, and animal response according to class, breed, age, condition, and environment? Possibly more cooperative research between animal husbandry or nutrition specialists and agricultural engineers could give the answer.

ING

# AGRICULTURAL ENGINEERING

VOL 20, NO 12 EDITORIALS DECEMBER 1939

## Twenty Volumes of AGRICULTURAL ENGINEERING

THIS issue closes the twentieth volume of AGRICULTURAL ENGINEERING. In these two decades great advances have been made in its field. We don't claim that AGRICULTURAL ENGINEERING is responsible for this progress, but we like to think that it has been a contributing factor. Progress in the application of engineering to agriculture created a need for the publication, made it possible, and launched it as an aid to further progress.

What were agricultural engineers thinking about "way back when," in 1920, in the early stages of the post-war agricultural depression?

They were surveying and discussing their field, looking for and pointing out to each other opportunities to be of service by applying engineering thought, methods, techniques, information, and engineered materials and equipment to farm problems.

In Volume I, F. N. G. Kranick, then president of the American Society of Agricultural Engineers, wrote on "Agricultural Engineering." W. A. Foster analyzed the "Agricultural Engineering in Farm Buildings." One B. R. Mullen wrote on "Drainage and the Agricultural Engineer." J. B. Davidson introduced the Journal with appropriate remarks.

Were agricultural engineers looking ahead? Perhaps in unconscious anticipation of the pneumatic tire, William Aitkenhead reported "Observations on Wheel Equipment." W. C. Zelle asked "What Form Will the Tractor Ultimately Take?" It was to be years before the soil erosion problem would be generally recognized and anything done about it on a large scale, but W. A. Steel wrote on "Solving the Drainage and Soil Washing Problems for the Farmers." Current recognition of animal requirements in the matter of shelter may have been foreshadowed in a paper on "Climatic Dairy Barns," by the late W. B. Clarkson and C. S. Whitnah. Another of their contributions was on the "Importance of Heat in the Ventilation of Hog Houses." L. J. Smith and J. P. Calderwood also reported on ventilation.

Ventilation, by the way, was progressing without benefit of electric fans. Electric power had another few years to wait before technical progress in power generation and transmission made it a promising subject for agricultural engineering consideration.

W. G. Kaiser was already thinking about the "Effect of Water on Strength of Concrete."

Drainage was a live subject. In addition to the two mentioned above, there were contributions from J. A. Reeves, David Weeks, O. W. Israelsen, and R. L. Patty.

L. J. Fletcher was author of a paper on "Tractor Service," and O. W. Sjogren invited consideration of the question "Why Standardize Tractor Ratings?"

Perhaps it is a fair commentary on the general state of farm home conveniences at the time to mention that H. R. Herndon reviewed "Sanitation in the South" in a short paper. W. Kirkpatrick had a contribution on "Gothic Roofs for Barns."

Applications of engineering directly in farm operation were considered by S. F. Morse in "Plantation Management from the Inside."

Metallurgical problems paralleling and associated with improvement in farm equipment were touched on by G. W. Rynders under the title of "Hardening Soft Center Steel Plow Shapes."

The interest and philosophy of irrigation at the time was reflected by the title "Subduing Arid Lands in the West," by A. R. Williams.

Authors in that first volume naturally divide into two groups, those who are still among the active leaders in the field, and those who have passed on or to other activities. The number still active is surprisingly large and significant. They were comparatively young men twenty years ago. Now, in addition to the continuing strength they lend to the group, the personnel of agricultural engineering is bolstered by a still larger number of younger men, thinking and working as those pioneers were twenty years ago, but in a field which is now better recognized and supported, which has a still larger view of its opportunities for service, and an improved technology with which to work.

What of the next twenty years? We do not venture to predict, but we have no concern so long as agricultural engineers continue to analyze and reappraise their field, their problems and opportunities, and their qualifications, and to work with a truly professional viewpoint. AGRICULTURAL ENGINEERING will continue to be their professional publication, one of the agencies which will measure, record, and assist their progress.

## Processing Farm Products

CREAM separation is one index, suggested by the frontispiece in AGRICULTURAL ENGINEERING for November, to how far farmers might go in processing other farm products for food or nonfood markets. If a centrifuge can be produced that will do a satisfactory job of separating cream with a specific gravity range of 1.018 to 0.986, from skim milk with a specific gravity of 1.037, and do it profitably under farm conditions with only 100 to 200 hours of actual machine use per year, comparable machine development and farm practice achievements seem possible in other fields.

Objectives or advantages of farm processing before marketing include separation and reduced handling of waste, impurities, or components of low unit value; separation of components to make possible different treatments or shipment to different markets; putting perishables in more stable condition for storage and shipment; putting materials in convenient bulk form or package units for shipment and use by the purchaser; saving and utilizing former wastes; and increased opportunity for economic service on farms, especially during winter months.

Farmers have demonstrated their capacity to handle machines as complicated as the modern combine or tractor; forces as intangible as electricity; separating operations as difficult as cream separation, grain cleaning, fruit juice extraction, and fruit and egg grading; heat-treatments as exacting as incubation, canning, pasteurization, and welding; chopping and grinding operations to the extent and within the limits required for animal feeds; bacterial and fungicidal processing as in silage, vinegar, and cheese making; packaging operations as heavy as baling hay and as delicate as crating eggs; sanitation requirements as detailed as for milk; and chemicals as poisonous as sprays and disinfec-

tants, as corrosive as fertilizers and sulfuric acid, as inflammable as gasoline, and as sensitive and explosive as dynamite caps. There have been serious accidents and heavy losses, but not enough to prevent progress and profit in the use of these machines, materials, forces, and operations.

While we urge and support every consideration for the safety of farmers in the introduction of new machines, electric devices, chemicals, and operations for processing farm products, it seems probable that creating and determining opportunities for farm profit in the operations may be more difficult than providing equipment, materials, and practices which farmers can utilize safely and correctly.

## Engineers and Unions

A DESIRABLE attempt to clarify the issue of unionization for engineers is being made by the American Society of Mechanical Engineers. James H. Herron, in *Mechanical Engineering* for November, submits some viewpoints as a basis for discussion and for consideration by individual engineers in determining the desirability of themselves becoming members of any specific labor union.

He supports the professional status of engineers and engineering as a prerequisite to the highest achievement, welfare, and satisfaction of the individual engineer. With that prerequisite in mind, he reduces the issue dispassionately to a question of what is and what is not consistent with the professional status, in the objectives and practices of existing unions.

Summarizing Mr. Herron's measure of what is professional, we find that it includes (1) work which is creative and requires original thought and is done in the spirit of ministering to the people, (2) a high sense of responsibility to the employer, the public, and others concerned, (3) a desire to be guided by ethics which have developed within the profession as a result of its experience, (4) fair compensation and steady employment as a basis of security, permitting whole-hearted attention to and performance of engineering work, and (5) acceptance of mental rewards such as satisfaction in work well done, knowledge of help to others, and recognition and respect of fellow workers as more important than material rewards.

Some observed attitudes and actions of some unions, which Mr. Herron indicates to be inconsistent with the professional status, are (1) exclusive concern for the economic well-being of members, (2) standardized work-week limits without regard to individual employer, employee, or job considerations, (3) overtime on an hourly-rate basis, (4) minimum wage scales without regard to individual cases, service rendered, buying power of the dollar, or the employer's ability to pay, and (5) otherwise superficial or one-sided outlook on economic and industrial problems.

These considerations raise a question as to whether any union, however desirable it might be for labor, can do anything for engineers which they cannot do better for themselves through their own professional organizations.

## Engineering to Biological Specifications

IN his paper published in the following pages, Harry E. Besley points out that the work of the agricultural engineer "begins after a set of conditions and possible limitations have been indicated by the agronomist, dairy husbandman, plant physiologist, or other specialists." This is welcome support and new wording on the field of agricultural engineering, which we have at various times attempted to picture as including the environmental factor in biologic production on farms.

In other words, numerous specialized biological sciences of agriculture study plant and animal life from the standpoint of heredity, and of resulting response to environment. These studies might well, and often do, lead to specification of the combinations of conditions found ideal for highest quantity and quality of production by any variety or breed of plant or animal at any and all stages of its development. In addition to specification of the ideal, these sciences can show the effect of measured variations from the ideal and indicate critical points in such variations.

Given a set of conditions and limitations covering the response to environment of any crop or livestock, the agricultural engineer has a sound basis on which to work toward effective environmental controls for profitable farming operations. It matters little whether he is concerned with research, development, advising farmers, or actually directing farm operations; he is concerned with modifying environment for specific purposes, and must look to the biologic sciences for the information on which to base his methods and objectives.

## Plowing Economy

ACCORDING to *The Implement and Machinery Review* of London, South African farmers are being taught a routine of tractor plowing designed to save time, fuel, gear shifting, plow lifting, and wear on equipment in connection with turning at the ends of the field.

Briefly, lands 100 yards wide or wider are opened with furrows starting and ending 20 to 25 yards in from the ends of the field. Five or more rounds are made in this manner, lifting the plow and making figure-eight turns at the ends, until the plowed area is wide enough that the tractor and plow can readily make a direct turn while plowing. From then on the land is plowed out in one continuous round, without lifting the plow or gear changing, holding wide at the corners to reduce to a minimum the headland to be plowed out later.

Is this different or more economical than common American practice? We don't know, but just such factors in equipment use methods are a means of realizing to the fullest the potentialities of modern farm equipment for low-cost operation.

## "Report of a Silo Survey"

TO THE EDITOR:

The reason for the apparent mistake in my paper on the above subject, pointed out by H. E. Besley, in AGRICULTURAL ENGINEERING for October, is as follows: The paper presented by McCalmont and Besley at the North Atlantic Section of the A.S.A.E. meeting in September 1938, was not identical with the paper published in AGRICULTURAL ENGINEERING for June 1939. I wrote my paper for the A.S.A.E. annual meeting in June 1939 before the McCalmont-Besley paper was published, and obviously I studied the paper as it was presented in September.

Their paper as it was presented, makes no distinction or mention of different sizes of silos when comparing the pressures of grass and corn silage. In fact, the fourth sentence reads as follows: "Since the system used to measure the pressures exerted by both corn and grass silage was the same, the pressure panel setup used for corn silage at Beltsville will be described, and for comparison the pressures in corn silage given." The size of silo containing corn silage was not stated.

The footnote to the statement in question should have referred to their talk as given, rather than to their published article in AGRICULTURAL ENGINEERING.

CHARLES H. REED

# Grassland Farming

By Harry E. Besley

MEMBER A.S.A.E.

GRASSLANDS may well be called the "redheaded stepchild" of American agriculture. Generally these areas have been too poor to support other crops or too rough to till. The grasses have been accepted as gifts of nature without thought of development. This picture is beginning to change, due to the efforts of men who are interested in the development of grassland farming which basically means the acceptance of grass as a crop, not merely as a gift of nature, and placing more emphasis on grasses and legumes in the farming program.

It has been said that America is now grass-minded, but still lacks much of the grass-consciousness that is apparent in Europe. Grass-mindedness is the culture of grass for a specific purpose, while grass-consciousness regards the specific purpose as incidental to the crop itself. Some specific purposes of grass culture worthy of note are for grass silage, pasture improvement, and soil conservation.

Much has been said regarding grass silage during the past few years. A recent reference list on the subject is voluminous. It is sufficient to say here that when winter roughages, including grasses, legumes, and cereals, are preserved as silage, it is possible to harvest the crop when nutritive value is highest without particular regard for weather conditions. When suitable machinery is available, harvesting and storing can generally be conveniently effected. Loss in nutrients while harvesting and during storage is usually low. Less storage space is required and the fire hazard is practically eliminated.

Pasture improvement, or, as it may be called, intensive pasture management, not only encourages better use of permanent pastures, but endeavors to provide plenty of succulent feed, weather permitting, throughout the growing season with the possibility of harvesting considerable silage material or hay from the areas not grazed during the spring. The development of new grasses is now a part of the pasture improvement program. As hardier, more productive strains of grasses are introduced, the pastures may be relied upon to yield a larger proportion of the feed requirements on the farm.

The development of grasslands and the growing of crops suitable for grass silage and hay are ideal from a soil conservation point of view. The acreage in tilled crops, such as corn, is reduced to provide space for the soil conserving grasses and legumes. Every acre removed from cultivation and provided with cover is an acre protected from erosion.

It is readily apparent that by combining several specific purposes of grass culture into a unified program, a definite move is made toward grassland farming. Complete elimination of tilled crops is not anticipated; the goal is a reduction in acreage with a consequent reduction in the heavier tillage operations. A rotation of approximately twelve years, now in use at the New Jersey Agricultural Experiment Station, may serve as an illustration. The ground is prepared and seeded to oats or oats and peas and a mixture of legumes and grasses. The legumes will die out in several years, but with proper fertilization and management the timothy should last for at least ten years without any reseeding. Corn may be used for one or two years at either end of the rotation as a cleaning crop, but there are still the ten or more years when tillage is unnecessary. With this system of farming most of the area will be set aside for the grassland program; those fields least subject to erosion may be used for the limited amount of cultivated crops required.

The methods described are not idle dreams of a few experiment station workers. Grassland farming in some form is being practiced and is gaining in favor in the Northeast, particularly in the dairy sections. It behooves us to look more closely at the changes that are taking place and see where we, as agricultural engineers, fit into the program. It seems that we should join forces with the animal and plant specialists to aid them in the solution of problems call-

Presented before a meeting of the North Atlantic Section of the American Society of Agricultural Engineers at Farmingdale, L. I., N. Y., September 14, 1939. The author is assistant professor of agricultural engineering, New Jersey State College of Agriculture.

(LEFT) MOWING ALFALFA ON THE BARBARA WORTH RANCH IN CALIFORNIA WITH A LIGHT TRACTOR AND 7-FT CUTTER BAR, AND CUTTING ABOUT 40 ACRES PER 8-HR DAY. (RIGHT) SILO FILLING WITH GRASS AND MOLASSES

Grassland farming creates new machinery requirements and opportunities. Heavier equipment is being developed to handle green forage. Windrowers are gaining in favor. Combined mowing, chopping, and loading is still beyond the reach of most farmers. New machines or adaptations needed include a conveyor elevator for silage, a device to remove ensilage from the silo, equipment to reduce labor at the ensilage cutter, inexpensive hay drying equipment, and a high-cutting mower for topping grass

ing for engineering knowledge. This is not an attempt to belittle the part the engineer is to play but rather to point out that he approaches greatest usefulness through cooperative assistance; and that his work, which may be true research, begins after a set of conditions and possible limitations have been indicated by the agronomist, dairy husbandman, plant physiologist, or other specialists. Indications are that the concentration of engineering effort in this problem should be on mechanical and structural improvements and developments.

The principal mechanical difficulties have resulted from the use of regular haying equipment to harvest the green crops which weigh three to four times more than hay. Existing machinery has been improved and strengthened to meet the new demands so that field breakdowns are now the exception rather than the rule. Silo fillers generally have been adapted to handle the green material without difficulty. Pumps have been attached so that the preservative may be added conveniently.

A canvass of the major farm machinery manufacturers less than a month ago reveals that considerable attention is being given to machinery for green crops, as the improvements indicate, and some developments are under way. However, there is nothing yet available to improve on present hay harvesting methods to handle the green crops. About the only changes from usual haying methods worthy of note are that windrowers are available to take the place of rakes and possibly a more liberal use is being made of dump trucks for hauling. With the windrower, fewer stones are picked up than with the rake, or when the loader is used to pick up the swath. It has proven quite satisfactory, except where the windrow must be turned uphill. There are one or two field choppers on the market, but at present the cost of these machines is not within the reach of the average farmer. At least one machine is being developed to cut, chop, and load the material. It is believed that a system of harvesting whereby all the field operations can be done with one inexpensive machine has real merit. With field-chopped material a method of elevation less costly than blowing should certainly be found. Introduction of preservatives in new forms such as citrus pulp, oat hulls, and similar materials which have been fortified with molasses may make it possible to use an elevator or conveyor to put the chopped material into the silo. Possibly someone might work out a system whereby the elevator could be used to remove the silage. This may sound fantastic, but anyone who has tried to remove grass silage which has settled and compacted until it can be loosened about as easily as the barn floor, might be a good customer for an unloader.

Aside from the elevation of the field chopped material, there are other questions to be answered, including how and when to harvest and how to lighten the work at the cutter. At the New Jersey station a cooperative investigation with the Bureau of Agricultural Chemistry and Engineering, U.S. Department of Agriculture, is under way to determine time, labor, power, and machinery investment requirements for harvesting and ensiling green forage crops other than corn. A comparison is being made of the various methods in use for harvesting grass. These include the mower with rake and hay loader, mower with windrowing attachment and loader, mower and pick-up chopper, and the combine which will cut, chop, and load the chopped material. Chopping and elevating methods are being studied with the idea of reducing the power demand. A drag type elevator has been built and while only preliminary trials have been made, indications are that the power demand may be less than 2 horsepower. Molasses is being applied at the cutter, in the fan housing, and at the top of the delivery pipe to determine what effect the place at which the preservative is applied may have on stoppage and the power demand. Additional investigations of machinery and methods may well be made at other stations where test facilities are available.

It is generally agreed that some hay is still necessary when grass silage is fed; therefore, the problems incident to hay making cannot be completely ignored. There is still the demand, wherever hay is made, for inexpensive equipment to facilitate quick curing. Improvements in equipment and methods to reduce harvesting and storage losses are also in order. The introduction of new pasture grasses, some of which will be cut for hay, may well bring on new and unforseen harvesting, or curing difficulties. We must be on the alert to cope with such a situation should it arise.

Intensive management of pastures has already brought on the demand for machinery improvements and modifications. One is a high-cutting mower that will top the grasses as they start to head out. The cutter bar on such a machine will have to function eight to twelve inches above the ground. The purpose of topping is to prevent the formation of seed and thereby encourage the formation of new undergrowth. A harrow is needed that will break up and distribute the droppings on the pasture. Spike-tooth harrows have been tried with little success. A fertilizer distributor that is reasonably accurate and mobile, yet inexpensive, is also needed.

While considering pasture management, it is well to note that several separate fields or plots suitable for successive grazing are required to properly carry out the program. Considerable fencing is necessary for this purpose, and it is here that a safe, effective electric fence unit could be used to advantage. There are some satisfactory units on the market but others are probably dangerous. Research to improve, develop, or lay down more exacting specifications for fence units is under way at several stations. Educational material to enable the prospective buyer and the owner to intelligently select and operate the units is certainly desired.

The grassland program is sure to have a decided influence

on farm building design. Already rumblings of changes are being heard and these will increase. With the hay requirements reduced, less storage is necessary, so there is likely to be a decline in the number of loft barns. The immediately apparent possibilities are single-story barns of fire-resistant construction designed for livestock alone, and silos for storage. Plans of several satisfactory barns are available so we need not dwell on this point. Silos, however, do present something of a problem. It is known that silage juices attack concrete. Wherever they are present considerable damage to concrete silos, mortar joints of block silos, and the concrete foundations of all silos may be expected. The logical approaches to a solution of this problem seem either to control the formation of juices or to make the concrete acid resistant.

Two methods are being advanced whereby silage juices may be controlled so as to practically eliminate the damage to the concrete. First is to wilt the green crop, thereby reducing its moisture content to between 65 and 70 per cent before ensiling. This has been practiced with some success, but it does require considerable experience and judgment to determine when the wilting has progressed to the proper stage. A weather factor is also introduced that might well be eliminated. If wilting is to be generally practiced, the advocates of grass silage will have to soft pedal the talk of "haying in the rain" and of ensiling the crop almost without regard for the weather. If a field cutter-chopper comes into general use, prewilting will not be practicable. A second method of juice control that is now being investigated at the New Jersey station is to add dehydrated preservatives such as citrus pulp fortified with molasses to the chopped material with the idea of absorbing the free moisture.

Acid resistance may also be approached from two different angles. It may be possible that concrete can be made to withstand the action of the silage acids or that coatings can be applied to give the necessary protection. Both of these possibilities are being investigated with the assistance of the U. S. Department of Agriculture, the Portland Cement Association, and a number of paint manufacturers. Reduced porosity of the concrete by the use of richer mixes and by the inclusion of waterproofing compounds in the mix is the approach being used to make the concrete itself more acid resistant. Coatings that are being tried include a variety of materials all the way from asphalts through the resins and rubber paints to paraffin wax.

The pressures exerted on the silo wall by grass silage, as well as corn, are receiving attention. It has been found that the lateral pressure of the grass may be as much as 19 lb per square foot per foot of depth and corn as much as 14 lb, both of which are somewhat above the 11 lb originally attributed to corn. To meet this additional pressure that may be exerted by the grass if ensiled with high moisture content, it is recommended that extra reinforcing be used. This will require a cash outlay by the farmer who wants to strengthen an existing silo and may increase the cost of new masonry silos as much as 10 per cent and wood silos even more. These recommendations have been criticised in some quarters on the ground that in most cases the pressure will be somewhat less than 19 lb and that grass has been put into existing silos for several years without serious trouble, except in silos that were in very poor condition, so why burden the farmer with additional expense? In answer to this it must be said that it is only sound engineering practice to design a structure for the most extreme conditions it may be expected to meet. The reinforcement recommendations have been made using a factor of safety of only about three, which is certainly very low and indeed a small margin when it is considered that corrosion, either from weathering or acids, may in time weaken the reinforcing hoops. Call the added reinforcing insurance, if you will, but put it on.

Throughout this paper there have been references to improvements in machinery and structures that are certainly most worth while. However, really new ideas are conspicuous by their scarcity. Precedent seems to have acted as a kind of muscle binder. Isn't it about time to shake loose a little? Why not one inexpensive machine to take care of cutting, chopping and loading; an elevator instead of a blower to fill the silo; a silo unloader; a conveyor to take the silage to the animals; building and farmstead layouts to eliminate lost motion; a jointless silo that is acid-resistant? This grassland program offers many possibilities for engineers with imagination. Let us take advantage of the opportunity.

## REFERENCES


Archibald, J. G. and Parsons, C. H. Haying in the Rain, A Study of Grass Silage. Mass. Agr. Exp. Sta. Bul. No. 362, April, 1939.

Bender, C. B. and Bosshardt, D. K. Grass Silage: A Critical Review of the Literature. Jour. Dairy Sc. 22: 637-651, 1939.

Bender, C. B. and Savage, E. S. Grass Silage. Its Place in Agriculture. N. J. Agr. Exp. Sta. Cir. 386, March, 1939.

Bender, C. B. Intensive Pasture Management. N. J. Agr. Exp. Sta. Bul. 633, Sept. 1937.

Cardon, P. V. Toward a Grassland Agriculture. Jour. Amer. Soc. Agron., Vol. 31, No. 3, March, 1939.

Hamlin, F. H. Grass Silage Harvesting Methods. Agr. Engr., Vol. 19, No. 7, 1938.

Hamlin, F. H. Grass Silage. Agr. Engr., Vol. 19, No. 11, 1938.

McCalmont, J. R. Silos. Types and Construction. U.S.D.A. Farmers' Bul. 1820, May, 1939.

McCalmont, J. R. and Besley, H. E. Pressure and Temperatures with Corn and Grass Silage. Agr. Engr., Vol. 20, No. 6, June, 1939.

Miller, Dalton G. Factors Which Influence the Durability of Concrete Stave Silos. Jour. Amer. Concrete Inst., Vol. 34, March-April, 1938.

Miller, Dalton G., Rogers, Charles F. and Manson, Philip W. A Flow Method for the Determination of the Effects of Soluble Chemicals on Concrete. Presented at the 42nd annual meeting of the Amer. Soc. for Testing Materials, June 26-30, 1939.


# Dust Explosion Committee Reports

THIS committee is working on new codes for the prevention of dust explosions in country grain elevators and in drug and insecticide plants.

In comparison with the ten-year period from 1919 to 1928, the ten-year period from 1929 to 1938, inclusive, showed a total reduction in losses from dust explosions of more than $8,000,000, David J. Price (Member A.S.A.E.), chairman of the committee, reports. This reduction in loss he traces directly to the adoption of the safety codes prepared by this committee and to compliance with their requirements. New industries are raising new problems, however, and in many cases research work must be carried on to determine the explosive characteristics of the new products, he declares. New manufacturing processes may also introduce new combinations of dusts, gases, and solvents for which additional information will be necessary to provide proper protection.

The economic importance of the work being done by this committee is shown in the record of the losses which the codes are designed to prevent. Some 400 dust explosions have occurred in industrial plants in the United States in the last 20 years, Mr. Price reports, more than 300 persons have been killed, nearly 700 others injured, and the property loss in insurance paid has amounted to more than $28,000,000. The loss from dust fires and explosions in country grain-handling plants in all the grain-producing states has been estimated as approximately $3,000,000 annually.—*"NFPA Committees Report Progress on Standards," "Industrial Standardization," October 1939.*

# The Milking Parlor for Small Dairy Farms

By K. B. Huff

MEMBER A.S.A.E.

THE milking parlor idea is becoming more and more popular on small dairy farms in Missouri as a low-cost housing method for the production of quality milk. It started in Missouri in 1932 with the construction of such a milking parlor on a privately owned farm near Columbia. The owner formerly milked his cows in a general-purpose barn and did the milk cooling in the basement of his home. In order to meet the standard milk ordinance for the production of grade A products, this farmer had, as many others have, four alternative methods of solving his housing problems as follows: (1) Build a new standard dairy barn, (2) remodel his old barn into a standard dairy barn, (3) separate part of the old barn, or (4) construct a new building to house the milking operation, the milk cooling, and the utensil and bottle washing.

The farmer decided on the latter method and constructed a three-room 16x24-ft building. The north room is a four-cow milking parlor. Two cows are turned in at a time. They have previously been curried in the old general-purpose barn, which is now being used as a loafing barn, so that they are ready to be fed and have the flanks and udders washed before the two-unit milking machine is attached. While the first pair is being milked, the next two are turned in, fed, washed, and prepared for the machine.

Sixteen to twenty cows have been milked in this barn using this system. The milk is strained, cooled, and bottled in the front corner room. The utensils and bottles are washed in the room opposite this milk room.

A study of this system of handling cows in comparison with that used in the standard milking barn, was made during its first year of operation. This study showed that there was a considerable saving in time in favor of the milking parlor. The time required for all operations in the parlor was 5.7 min per cow as compared to 7.8 min for all operations in the standard milking barn. Part of the 2.1 min difference was accounted for in the additional time taken to record the milk for individual cows in the standard milking barn studied. Most of it was due, however, to the smaller area required for the work.

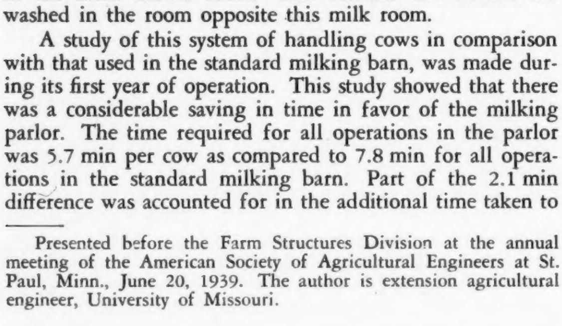
Since 1932 many other small to medium-sized dairy farmers near Columbia, as well as a few in other sections of the state, have constructed new or remodeled old barns into similar milking parlors. These parlors vary in size from two to ten-cow capacity.

In talking with many of the operators of these dairies, several points are brought out by practically all of them. The milking parlor idea is liked because it is low in first cost, convenient to use, and is a very easy method of producing a quality product. The mistake is often made of making the milking parlor, milk handling room, and the wash room too small. Milking stalls are usually made too narrow for the convenience of the operator. The convenient location of a feed room is often neglected. An enclosed hall providing a double-door connection between the milking parlor and the milk handling room would be much more satisfactory than carrying the milk outside from the milking parlor.

A new arrangement for the loafing barn is being tried by a few farmers. This plan differs from the one explained in that the milking stalls are arranged in tandem.

A general-purpose barn has been remodeled into a grade B dairy plant by adding an 18-ft shed along the west side. One-half of the old barn and part of this new shed are being used as a loafing barn for a twelve-cow herd. The rest of the shed addition is divided into a milk-handling room and a milking parlor. The milk handling room and the work alley in the loafing barn are connected by a small hallway with double doors. The two milking stalls are one behind the other and are connected to the loafing barn with a door which opens into a hallway alongside these two stalls. All the doors are controlled from the work alley. Practically the same method of handling cows as in the regular milking parlor is used in this *(Continued on page 464)*

Presented before the Farm Structures Division at the annual meeting of the American Society of Agricultural Engineers at St. Paul, Minn., June 20, 1939. The author is extension agricultural engineer, University of Missouri.



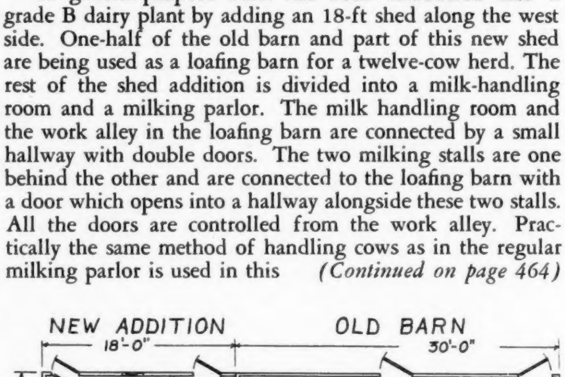



FIG. 1 (LEFT) OLD BARN IN BACKGROUND IS USED AS LOAFING BARN. COWS ARE MILKED IN ROTATION OF PAIRS IN THE FAR END OF NEW MILKING BARN; THE MILK IS STRAINED, COOLED, AND BOTTLED IN THE FRONT CORNER ROOM AND THE UTENSILS AND BOTTLES ARE WASHED IN THE ROOM OPPOSITE THE MILK ROOM. FIG. 2 (RIGHT) FLOOR PLAN OF GENERAL-PURPOSE BARN REMODELED INTO A GRADE B DAIRY PLANT BY ADDING 18-FT SHED TO PROVIDE SPACE FOR A MILK HANDLING ROOM AND A TWO-COW TANDEM TYPE MILKING PARLOR

# More Flexible Farm Buildings

By Harold E. Pinches

MEMBER A.S.A.E.

MANY types of agriculture are as dependent on buildings as on any other one factor. Indeed, in many states it would be hard to compare the value of a dairy barn with feed for the cows, for without the barn there would be no dairy. The same thing can be said for poultry in the colder parts of the country, and for such crops as tobacco and sweet potatoes.

In all these types of farming, the necessary investment in buildings is relatively large, even on a minimum basis. Often the buildings are worth as much or more than the land contained in the farm. The cost of the necessary structures, on which any farming enterprise may depend, is so great that it may take all the resources of the farmer for many years to pay for them.

As farming becomes more specialized and more competitive, the trend in building design is in the direction of greater adaptation to a single enterprise. Efficiency factors may dictate such design. Public health regulations have a part in some cases. Specialization of activity makes unnecessary many features of general-purpose barns.

Such specialization of buildings around single enterprises is natural and desirable on a short-time basis. On a long-time basis the situation may be quite different.

The more a building is adapted to one purpose, the less easy, in general, it is to change it to some other use. Increasing specialization brings with it increasing rigidity of use. This rigidity of use of buildings was not serious in the past, when agriculture was more self-sufficient in any region, and regionally stable. But recent years have brought change and fluidity into the agricultural situation everywhere. Developments in transportation have opened new markets to many regions and, frequently, have meant a penetration of competition into formerly independent regions hundreds or thousands of miles away. Crop surpluses have stimulated farmers to attempt shifts to other farming enterprises. Shifts in demand due to changes in style, or to population shifts are operating with greater rather than less force. Government control programs set the more aggressive farmers to looking for noncontrolled products.

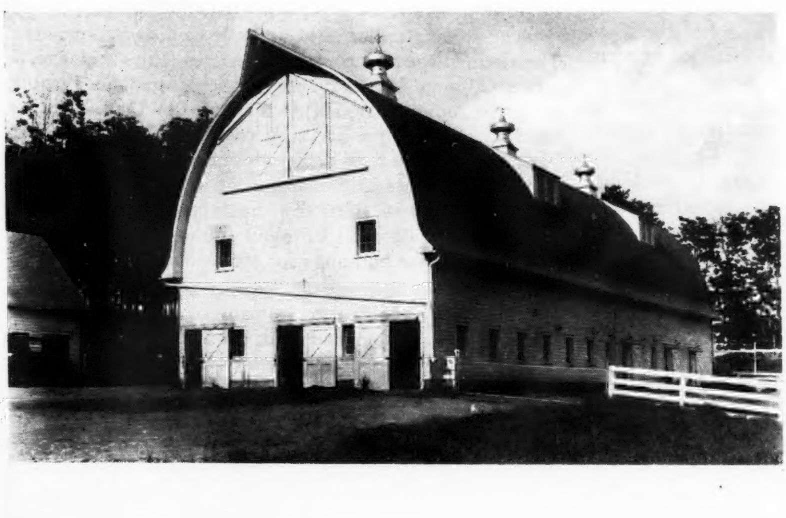
All these factors call for greater flexibility in farmers' plans at the same time that buildings are becoming less flexible in design. Any farmer may face the desirability, if not the necessity, of shifting from one type of production to any other which may be possible in his locality. Changes in market requirements, export opportunities, regional competition, and many other factors make unprofitable, in a few years, farming enterprises which have been well established locally for a long time. The necessary shifting can be done fairly easily in some types of agriculture, but in those types most closely associated with a large development of farm buildings, it is much more difficult. The specialized nature of buildings, as usually developed, and the large investment in them often "freezes" the possible activity on a particular farm.

The question which arises is whether farm structures can be created with more *universality of design* so that a building could be shifted in use, somewhat as crops can be changed within the limitations of a particular field. In raising this question, there is no thought of proposing an "in-and-out agriculture," but simply that we, as agricultural engineers, look far enough ahead to satisfy ourselves that we are not needlessly imposing possible future handicaps through the building designs we put out. This forward look seems especially pertinent at this time when regional plan services are being set up. These plan services are very desirable but they should be protected against codifying limitations of use.

Some support is given to the hope that more universality of design can be attained by an examination of the functions of farm buildings. Aside from aesthetic values, there are just three major functions of any farm building. These are (1) storage, (2) air conditioning, and (3) provision of efficient working conditions.

To attempt to get all three in one building may at times mean considerable compromise. Or, if all are equally well worked out, the cost of the structure may be high, and the design such that conversion to other uses is difficult. For example, consider the hay loft of the traditional

Presented before the Farm Structures Division at the annual meeting of the American Society of Agricultural Engineers at St. Paul, Minn., June 20, 1939. The author is head of the agricultural engineering department, University of Connecticut.



THE TREND IN BUILDING DESIGN IS IN THE DIRECTION OF GREATER ADAPTATION TO A SINGLE ENTERPRISE. EFFICIENCY FACTORS MAY DICTATE SUCH DESIGN. PUBLIC HEALTH REGULATIONS HAVE A PART IN SOME CASES. CAN SUCH REQUIREMENTS BE MET WITH DESIGNS AND EQUIPMENT EASILY ADAPTABLE TO A WIDER RANGE OF USE? *Louden photo.*

dairy barn with its necessity of carrying many tons of bulky, combustible material under a self-supporting roof and over the stable—that is, storage over the space which combines the other two functions of air conditioning and work areas. Consider how much good engineering has gone into the present highly perfected buildings of this type, and yet how much they cost per productive unit and how many of them are lost every year through fire and wind. And, what can be done with much of the space so enclosed, if the farmer wishes to change from dairying to something else?

While the two-story dairy barn with self-supporting roof may be an extreme example, it is such extremes that bring out possibilities more clearly. Considering the storage part of such a barn, may it not be separated from the other functions, and removed structurally even if only by a few feet? Is not the vertical cylinder resting on the ground essentially the cheapest, most stable, self-supporting structure possible for storage purposes?

I question whether the silo, as set up rather haphazardly beside the barn for storage of corn silage only, has had the development of possibilities which are inherent in it. Diameters and heights have been controlled by feeding rates of corn silage for certain size herds. More often than not there has been only one such structure on a farm and that for a single purpose. How different would be a battery of cylinders of varying diameters and heights, some ventilated with flat, conical, or simple A-frame roofs. Properly integrated and using modern machinery they should be simple to load and unload. Such a system should provide storage for almost any material which is adapted to bulk storage.

Turning to the non-storage buildings, they seem very specialized, but here too there are only a few essentials. Since they are all animal shelters, work spaces (for shelter of men and machines), or processing rooms (e.g., tobacco curing), they all are air-conditioning structures. Air conditioning, wherever it is found, involves a reasonably airtight and watertight structure by which heat transfer, air movement, and humidity can be controlled. There are large differences in degree of control over these elements in different farm buildings as now developed, but experimental results and practical trends are generally in the direction of more complete and more positive control in the types of buildings least highly developed in this respect.

There are only a few unit dimensions which will continue to have a strong influence on design. One is the 16 to 18-ft width of one string of cows in stanchions with feed and litter alleys. The pen-barn and milking-parlor system of herd management eliminates this as a necessary dimension. Another fundamental dimension is the 7 to 8-ft height necessary for comfort and convenience of men, regardless of height of animals or birds for which the shelter is built. The height to which men can lift boxes or crates from one staging is another fairly constant dimension.

Windows for light and ventilation do not have the importance for design which they once had; electric lighting and fan-controlled ventilation offer the opportunity for more flexibility here. Horse stalls have been standardized around the dimensions of a horse, but it is questionable whether many new horse barns should be built without giving thought to whether the framing of the building, depth of stalls plus alleys, and possibilities of exterior approach are easily adaptable to garaging tractors and trucks. Poultry houses were once shallow "chicken coops" for maximum exposure to sun—and, incidentally, to all the other elements of weather. The last few years have seen a decided trend toward poultry houses comparable to dairy barns in size, quality of construction, and degree of control over air conditions.

Some items of structural equipment are apparent problems in connection with multiplicity of use. Dairy cow stanchions are outstandingly specialized equipment. But there is nothing inherent in them which would prevent them being designed for movability as well as rigidity. The same can be said for all types of partitions. The gutter in the dairy stable could be filled, upon the occasion of a change to another enterprise, with precast blocks set in mastic which could be removed without loss for a return sometime to dairy.

Finally, it seems that less specialization should permit better building. Multiplicity of possible uses should allow depreciation, in the economic sense, over a longer period of years, and thus justify a quality of structure in which physical depreciation would be very slow. Good buildings could well be permanent buildings, if they were so designed as not to become obsolete through shifts in farm or regional enterprises. The alternative is cheap buildings with a shorter life, which can be abandoned when change is desirable and which will not retard the making of changes. Future designing of farm buildings should proceed on the basis that it is no longer true that "once a dairy farm, always a dairy farm," or that western and southern farms will continue indefinitely as strictly cash crop farms.

In making these proposals, there is no thought that one type of building will soon be designed to take care of all farm needs. It is not expected that all specialization will disappear; probably that is not possible or desirable. What is suggested is that here is a relatively unexplored field for research and development. It is a field to which the various manufacturers of equipment, the building materials associations, and a possible farm buildings institute could give considerable attention.

## The Milking Parlor for Small Dairy Farms

*(Continued from page 462)*

arrangement, except that the cows need not be backed out of the milking stalls, but can leave the stall through the door at the front. This makes for smooth handling of the cows.

The operator who is using this particular barn is very much enthused about it. However, there is a wide variation in attitude toward the practicability of this barn.

The milking parlor idea is rapidly gaining in popularity. The detailed method used in various localities seems to be influenced quite largely by the first few installations in that particular community. This is illustrated by the fact that in one community in the northeast part of the state, the milking parlors are built of sufficient size so that the herd may be milked in three shifts. Eight and ten-cow milking parlors for twenty to thirty-cow herds predominate. There seems to be quite a bit of room for improvement in the planning of these buildings for convenient operation.

The dairy department of the University of Missouri is very anxious to accumulate as many of the practical ideas now in use as possible, and work out a few model plans for various types of milking parlors and get this material in shape for distribution.

Present trends thus indicate that in a short time many more of these small milking parlors will be in use.

# Energy Consumption of Electrically Operated Dairy Farm Equipment

By J. R. Tavernetti
MEMBER A.S.A.E.

DURING 1937 and 1938, the California Committee on the Relation of Electricity to Agriculture conducted a study of the energy consumption of electrically operated dairy farm equipment. The object of the study was to determine the cost of operation and the load factor of various electrically operated equipment in actual operation on farms. Twenty dairies located in three different geographical areas of the state were selected for the study. The dairies ranged in size from 30 to 150 cows, and all except one retail dairy were selling grade A market milk in bulk. The energy consumption was obtained by installing a watthour meter on each individual piece of equipment and reading the meters once each month for a period of one year. In addition to the energy consumption, data were also obtained on the number of cows milked, the quantity of milk produced, and the general description of the equipment. Included in the study were 15 refrigerating units, 13 milking machines, 9 domestic pumps, 9 sterilizers, and 4 sets of dairy lights.

In Table 1 and Fig. 1 are shown the summarized data for the equipment on all of the dairies on a per cow basis. In Fig. 2 are shown the data for an individual dairy on which all the equipment was operated by electricity and on which home and dairy were connected to the same meter. The dairy equipment on this farm consisted of a 5-kw sterilizer of the type in which the heating unit is located in the sterilizing chamber, a one-hp two-unit milking machine, a 3/4-hp refrigerating unit which cooled the milk on an aerator and a 4x5x8-ft storage room, a 1/4-hp pump for circulating the brine through the aerator, and a one-hp domestic water pump. The milking barn, milk house, and yard were equipped with lights. In the farmer's home were lights, water heater, range, and a number of household appliances. In the winter electricity was also used to some extent for space heating. The equipment on this dairy was well designed and efficiently operated. The milk production varied between 3 and 4 gal per cow per day.

*Sterilizers.* All of the sterilizers, except No. 1, were of the pressure or boiler type with separate sterilizing chambers. Sterilizer No. 1 was a self-contained type in which the heating unit was located directly in the sterilizing chamber. The boilers varied in capacity from 12 to 18 gal and, with the exception of No. 7, were set for a maximum pressure of 15 to 25 lb. The common practice was to turn the boiler on so that the maximum pressure would be reached about the time the washing of the equipment was to be done. The equipment was first washed in water heated by steam and then placed in the sterilizing chamber which was also heated by steam. Very few of the sterilizing chambers were equipped with thermometers and the temperature was a matter of guesswork. The aerators were usually sterilized in place by turning live steam from a hose onto the surface. The sterilizing chambers were all made of galvanized iron and were uninsulated. Many of them were larger than necessary. Sterilizing was done at least once a day and sometimes twice a day.

With the exception of two sterilizers (Nos. 4 and 7), the energy consumption per cow per month was less than 10 kwhr and averaged about 7 kwhr. Sterilizer No. 4 was used on a retail dairy where a considerable amount of glassware was sterilized. Sterilizer No. 7 was set for a maximum pressure of 100 lb and was used regularly twice a day. The load factor for the sterilizers averaged 7.4 per cent with an average connected load of 12 kw. The energy consumption

The author is assistant agricultural engineer, University of California.

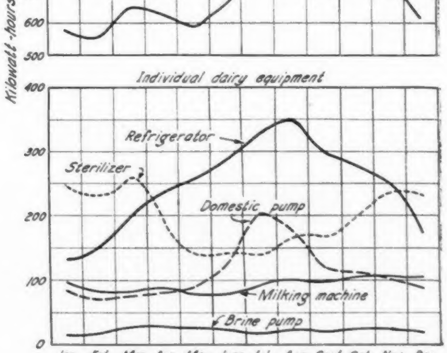
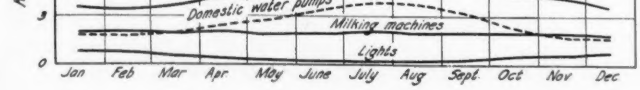



FIG. 1 (BELOW) AVERAGE MONTHLY ENERGY CONSUMPTION PER COW FOR THE VARIOUS EQUIPMENT ON ALL DAIRIES. FIG. 2 (RIGHT) ENERGY CONSUMPTION BY MONTHS ON ONE THIRTY-COW DAIRY



and load factor were greatest in the winter and least in the summer.

*Milking Machines.* The milking machines were all of the pipe-line type and varied from two to four units. With the exception of four machines, the energy consumption was less than 2 kwhr per cow per month. The load factor in most cases ranged between 15 and 20 per cent, and averaged 18.5 per cent. The energy consumption and load factor remained practically the same throughout the year.

*Refrigerators.* All of the refrigeration systems cooled the milk through an aerator. On dairies where the milk was shipped twice a day there was no storage space, while on the dairies shipping only once a day the milk was stored in a refrigerated room or box. About 70 per cent of the installations were direct-expansion systems while the others were brine. On the six dairies where the milk was cooled and not stored, the energy consumption was approximately 3 kwhr per cow per month. On the dairies where storage space was also refrigerated, the energy consumption ranged from 4.4 to 11.4 kwhr per cow per month. Six of the nine dairies with this type of system used approximately 5 kwhr per cow per month, while the other three used about twice that amount. Two of the latter three dairies had storage rooms considerably larger than necessary. The load factor ranged from a low of about 10 per cent to a high of 50 per cent, with an average of 26 per cent. The energy consumption and load factor were greatest during the summer and least in the winter.

*Domestic Pumps.* The domestic pumps were both plunger and centrifugal type, pumping into either pressure or elevated tanks. The lift varied according to the location of the different dairies and the season of the year, ranging from 40 to 100 ft. In all the dairies the pumps furnished water for the home and garden as well as for the dairy. The amount used solely for the dairy was not determined but was estimated at about 50 per cent. The energy consumption varied between 1 and 6 kwhr per cow per month, with an average of about 2.5 kwhr for all pumps. Of the nine pumps observed, only three used an average of more than 2.5 kwhr per cow per month. The maximum load factor for any of the pumps was 27 per cent, with two-thirds being less than 15 per cent and the average being 13.4 per cent. The energy consumption and load factor were greatest during the summer months and least during the winter months.

*Lights.* The lighting in the barns and milk houses varied considerably in the different dairies. Those dairies with relatively new buildings usually had good lighting, while the old buildings were poorly lighted. The total connected load on all the dairies was less than one kilowatt. The energy consumption on three of the four installations observed averaged 0.4 kwhr per cow per month and on the other 1.2 kwhr. The energy consumption was greatest in the winter months and least in summer.

TABLE 1. SUMMARY OF DATA ON ENERGY CONSUMPTION OF DAIRY EQUIPMENT

| Dairy No. | Average number of cows | Connected load | Kwhr per cow per month Range | Average | Average load factor, per cent |
|---|---|---|---|---|---|
| | | **STERILIZERS** | | | |
| | | kw | | | |
| 1 | 29 | 5.0 | 4.4– 9.1 | 6.8 | 5.5 |
| 2 | 41 | 10.0 | 5.7– 7.1 | 6.6 | 4.1 |
| 3 | 48 | 5.0 | 6.2– 7.7 | 6.9 | 9.2 |
| 4 | 46* | 10.0 | 16.0–24.8 | 18.5 | 12.9 |
| 5 | 57 | 15.0 | 6.2–10.9 | 8.9 | 4.5 |
| 6 | 65 | 15.0 | 7.3–11.5 | 9.5 | 5.6 |
| 7 | 80 | 15.0 | 10.9–18.2 | 14.9 | 11.1 |
| 8 | 119 | 15.0 | 5.2–11.2 | 7.1 | 7.6 |
| 9 | 131 | 15.0 | 3.5– 6.7 | 4.8 | 5.7 |
| *Bottled milk dairy | | | | | |
| | | **MILKING MACHINES** | | | |
| | | hp | | | |
| 1 | 29 | 1.0 | 2.7–3.8 | 3.2 | 16.0 |
| 2 | 35 | 0.5 | 1.6–2.3 | 1.9 | 18.3 |
| 3 | 38 | 0.5 | 1.2–1.9 | 1.6 | 16.8 |
| 4 | 37 | 1.0 | 3.3–4.0 | 3.8 | 18.8 |
| 5 | 46 | 0.5 | 1.9–2.6 | 1.9 | 24.1 |
| 6 | 48 | 3.0 | 4.2–5.2 | 4.1 | 18.1 |
| 7 | 57 | 1.0 | 1.5–2.4 | 1.9 | 14.9 |
| 8 | 59 | 1.0 | 2.5–2.7 | 2.5 | 16.2 |
| 9 | 65 | 1.0 | 1.3–1.9 | 1.6 | 14.3 |
| 10 | 85 | 1.5 | 1.5–1.9 | 1.7 | 21.0 |
| 11 | 92 | 1.0 | 1.6–2.1 | 1.4 | 17.7 |
| 12 | 96 | 3.0 | 1.1–1.5 | 1.3 | 17.2 |
| 13 | 130 | 1.0 | 1.4–1.7 | 1.5 | 26.9 |
| | | **REFRIGERATORS** | | | |
| | | hp | | | |
| 1 | 29 | 1.0† | 4.5–13.8 | 9.2 | 36.7 |
| 2 | 38 | 2.0 | 3.7– 7.1 | 4.8 | 16.8 |
| 3 | 41 | 2.0 | 3.1– 5.8 | 4.4 | 15.5 |
| 4 | 44 | 1.25† | 6.9–13.4 | 9.6 | 45.0 |
| 5 | 48 | 3.0† | 8.5–14.8 | 11.4 | 28.0 |
| 6 | 57 | 3.0 | 5.0– 7.4 | 5.8 | 16.9 |
| 7 | 59* | 2.0 | 3.1– 3.6 | 3.3 | 15.8 |
| 8 | 65* | 5.0 | 2.8– 4.2 | 3.6 | 10.8 |
| 9 | 80* | 2.0 | 2.4– 3.2 | 2.9 | 21.3 |
| 10 | 85 | 2.0 | 3.8– 7.5 | 5.1 | 49.8 |
| 11 | 96 | 2.75† | 3.4– 5.5 | 4.6 | 39.3 |
| 12 | 92* | 2.0 | 2.7– 3.5 | 3.0 | 18.1 |
| 13 | 119 | 3.25† | 4.0– 6.1 | 4.5 | 29.6 |
| 14 | 130* | 1.5 | 1.6– 2.0 | 1.7 | 20.3 |
| 15 | 147* | 3.0 | 1.9– 3.5 | 3.0 | 30.3 |
| *No storage | | | | | |
| †Brine systems (includes brine pump motor) | | | | | |
| | | **DOMESTIC PUMPS*** | | | |
| | | hp | | | |
| 1 | 29 | 1.0 | 2.4–7.1 | 3.8 | 22.0 |
| 2 | 35 | 2.0 | 1.1–4.1 | 2.3 | 7.3 |
| 3 | 38 | 1.0 | 0.6–1.5 | 1.0 | 5.2 |
| 4 | 41 | 0.5 | 2.0–3.0 | 2.4 | 27.2 |
| 5 | 44 | 3.0 | 3.2–9.6 | 6.1 | 11.2 |
| 6 | 48 | 2.0 | 1.0–2.6 | 1.7 | 5.6 |
| 7 | 59 | 1.0 | 1.5–2.7 | 1.9 | 17.2 |
| 8 | 92 | 3.0 | 2.4–6.7 | 4.0 | 12.1 |
| 9 | 96 | 1.0 | 0.6–1.6 | 1.0 | 13.2 |
| *Includes water pumped for homes and gardens | | | | | |
| | | **LIGHTS** | | | |
| | | kw | | | |
| 1 | 38 | 0.8 | 0.1–0.8 | 0.4 | —— |
| 2 | 44 | 0.8 | 0.8–1.8 | 1.2 | —— |
| 3 | 96 | 0.5 | 0.1–0.9 | 0.4 | —— |
| 4 | 130 | 0.8 | 0.1–0.6 | 0.4 | —— |

## CONCLUSIONS

The data obtained in the study showed that the energy consumption on an average dairy producing grade A market milk and using electrically operated equipment for milking, cooling, sterilizing, lighting, and water pumping is from 15 to 20 kwhr per cow per month. Excluding the sterilizer, the connected load ranges from 3 to 5 hp for dairies from 30 to 100 cows, and has a load factor of 15 to 25 per cent. The connected load of the sterilizers is from 5 to 10 kw for dairies of 30 to 60 cows and 15 kw for dairies with over 60 cows. The load factor of the sterilizers is less than 10 per cent. With the exception of the milking machine, the energy consumption and load factor of the different equipment varies with the seasons of the year, but the total tends to remain constant as the changes in the refrigerator and domestic pump are offset by those in the sterilizer and lights. In general, the design and efficiency of the equipment and the efficiency of the operators are as important factors in determining the energy consumption and load factor as is the size of the dairy.

# Trends in One-Story Barn Construction

By J. F. Schaffhausen

A CAREFUL study of certain areas of the United States—principally the northeastern states, the lake states, and Iowa, Kansas, and Nebraska, indicated that dairying produced the largest cash income and that immediate expenditures for building materials in this field seemed most likely because of the following conditions:

1 New city health laws were imposing stringent regulations on production and handling of milk, making present buildings obsolete in many instances. Instead of going out of business, the farmer would most likely make the required changes.

2 The fire hazard, according to available figures, is still more than $100,000,000 and barn fires exact the largest portion of this loss. As many farmers have given up diversified farming and are now specialists, it is likely that 60 per cent or more would rebuild after a fire.

3 The tendency in present-day farming to separate the dairy herd from other types of livestock make additional buildings necessary.

4 The development and acceptance of grassland farming as a practical, economical type of operation is changing the building requirements rapidly.

These factors would indicate that the dairy barn problem could be solved with a one-story type of building. Cooperating with an eastern agricultural college, a few industrialists and practical farmers made an effort to develop a one-story unit that would be economical yet practical. They set up the following tentative requirements as a basis of study:

1 Fireproof exterior
2 Fireproof or fire-resistant interior
3 Freedom from vermin
4 Adequate dependable ventilation
5 Proper insulation
6 Sanitary walls and ceilings that could be easily cleaned
7 Motion study to eliminate extra labor
8 Desirable type of construction
9 Lowest possible maintenance requirements
10 Cost per head not to exceed $100
11 Unit type of construction
12 Good general appearance.

Paper presented at a meeting of the North Atlantic Section of the American Society of Agricultural Engineers at Farmingdale, L. I., N. Y., September 14, 1939. The author is agricultural engineer in charge of rural development, Johns-Manville Corporation.

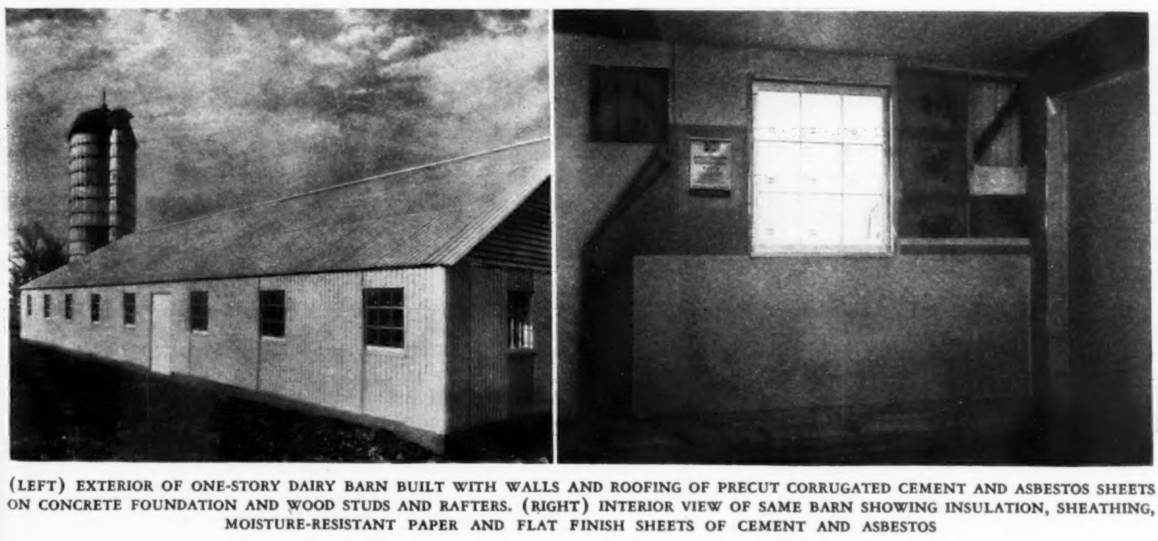
A product that has been used as roofing and siding by industry for twenty-three years came to play an important role in this development. Consisting of monolithic corrugated sheets of portland cement and asbestos, they are so structurally strong that they can be used for roofing and siding when supported on 4½-ft centers. No sheathing is necessary under the material, and it offers the added advantage of being fireproof, rotproof, maintenance free, and gray-white in color.

The manufacturer's sales policy allowed this material to be precut to size at the factory, so that in reality the roofing and siding needed for a job could be shipped ready cut for erecting. Cutting on the job was eliminated, except for gable ends and occasional door openings.

The building unit was so designed that only five sheet lengths were utilized and each length varied in size so markedly that it eliminated the "hunt-and-find" method so common with ready-cut materials.

Thus we not only borrowed a roofing and siding material from industry, but also a system of rapid erection with little waste, which reduces labor costs considerably.

The interior of the building is sheathed with ⅝-in plywood or ⅞-in sheathing, over which a vaporproof paper is applied in accordance with the standards outlined by the U. S. Forest Products Laboratory. The interior finish material is applied over this in the form of flat, dense, hard, gray-white sheets of cement and asbestos fiber. These flexible sheets are washable and sanitary. They require no battens at



(LEFT) EXTERIOR OF ONE-STORY DAIRY BARN BUILT WITH WALLS AND ROOFING OF PRECUT CORRUGATED CEMENT AND ASBESTOS SHEETS ON CONCRETE FOUNDATION AND WOOD STUDS AND RAFTERS. (RIGHT) INTERIOR VIEW OF SAME BARN SHOWING INSULATION, SHEATHING, MOISTURE-RESISTANT PAPER AND FLAT FINISH SHEETS OF CEMENT AND ASBESTOS

the joints, yet meet the most stringent health regulations in this country. This material is also fireproof and maintenance free, and as permanent as the stone from which it is made.

The ventilation for this type of construction was given serious consideration. The usual ridge ventilators were omitted, and in their place a specially constructed louver was placed in each gable end. This construction eliminated the possibility of snow eddying into the chamber but allowed sufficient air to enter. The usual waste space under the roof is thus utilized as a partial plenum chamber where the outside air can still. From this chamber the usual intake units bring air into the barn through the ceiling and diffuse it evenly over spreaders. Back draft dampers are provided in these units.

Electric fans are used for exhaust and are located in the leeward wall directly under the ceiling. These exhaust fans are provided with hoods and have sufficient output to maintain a constant change of air under the most adverse conditions.

In extreme cold climates the exhaust air is picked up near the floor and carried through a flue and exhausted at ceiling height. Numerous check installations indicate that satisfactory results are obtainable with this method, either by manual or thermostatic control.

To assure proper ventilation and temperature this one-story barn was insulated in sidewalls and ceiling with rock wool of a thickness equal to that recommended by the U. S. Department of Agriculture. This insulation is in batt form backed with a vapor-seal paper that provides flanged edges so that they can be secured on 24-in centers. This insulation is fireproof, providing additional protection to the studding that is fire-stopped as an added precaution.

In cold climates, all windows should be provided with storm sash.

I have visited these installations when outside temperatures ranged from –8 to –14 F and found no evidence of condensation on side walls or ceiling, except on window panes.

It is doubtful that this type of building can burn, as it is protected inside and out with fireproof materials. In addition, stud spaces are partially filled with incombustible insulation. Due to the scarcity of combustible materials any fire that developed would probably only smoulder and could easily be controlled.

As previously mentioned, the building is designed in units so that it can be extended to meet future requirements. It is only necessary to remove the fasteners and take down the corrugated asbestos which is practically 100 per cent salvageable.

#### CONSTRUCTION TIME AND COSTS

Past experience indicates that a 40-cow barn of this type can be built for as low as $87.63 per head. This cost includes all materials, foundations, equipment, and labor. This of course is based on time and material erection with labor figured on an hourly basis at 50 cents for unskilled and 65 cents for skilled. Where contract labor has been used, the costs have varied from $93 to $105 per head, that is, where union labor rates prevailed.

An outstanding feature of this development seems to be the fact that the farmer is receiving more building value in the form of more expensive materials at a lower over-all cost. This is due to savings made by precutting large sheet types of materials that are simple to erect and go in place rapidly. On a job that was under the supervision of a leading agricultural college, the records indicate that only a total of 882 hours of unskilled and 370 hours of skilled labor were required to complete a 40-cow barn and milk house.

To the agricultural engineers this should mean more than just another type of building construction. It indicates a new trend in agriculture. A large national organization is seriously interested in the farm market and is making available asbestos construction at prices that the average farmer can afford. Many of you know that these developments are made possible by college cooperation, and that along with this development work a program of national scope is being undertaken to educate the building materials dealer in the requirements of good farm buildings. This development should be watched closely, as the use of similar materials is rapidly spreading to other types of farm buildings. It is likely that further study and research will develop an asbestos sheet that would be available at a lower price and may have the added advantage of standard colors.

# Courage and Vision in Engineering

IN ORDER to determine what further educational benefits industry should desire for its employees who already have a college education, it might first be well to state the fundamental purpose of industry which is: To make more goods for more people at less cost and to maintain sufficient profits so that new projects can be financed.

In order to accomplish all these purposes, the new ventures must create new markets. The combined economy of the nation does not gain much when new manufacturers enter old fields merely imitating existing products and throwing people out of work in already existing companies. The only justification for a new company entering an old field is when the new company can make a real contribution either in greatly improved design, better manufacturing methods, or better sales and distribution.

Our country needs courageous leadership which will develop and exploit new and unusual projects and be willing to make an educated gamble of sufficient advertising and sales-promotion funds to obtain a large percentage of the business with consequent cost and price reductions sufficient to discourage unfair imitative competition.

It is adventurous leadership which has made America great in the past and will be needed to preserve us economically as well as politically from the competition of the dictatorship countries.

Why is this emphasized in a paper on postcollegiate education? Because this courage to adventure with confidence into unknown fields is one of the first requisites for leadership in industry and engineering. Business leadership has been courageous. Men have led, have risked greatly, and have shown great fortitude under adverse conditions. The hope of high profits induced men to take great risks. Under present conditions, however, people hesitate to invest in new enterprises because they believe the possibilities of profits have been reduced by economic control and taxation. A study of history would show them, however, that, although there have been periods more favorable to business, successes were made throughout the ages in more hazardous periods by people with courage.—*From "Requisites for Engineering Leadership," by A. R. Stevenson, Jr., in MECHANICAL ENGINEERING for December.*

# Transport Wheels for Agricultural Machines

## II. Rolling Resistance of Individual Wheels

By Eugene G. McKibben and J. Brownlee Davidson
FELLOW A.S.A.E. CHARTER A.S.A.E.

SUMMARY

ROLLING resistance determinations are reported for 23 wheels, 6 steel and 17 pneumatic, at 3 loads on 4 road and field conditions (See Fig. 1 and Table 3).

2 Additional rolling resistance determinations are given for eight of these wheels at one load on five winter and early spring field conditions (See Table 4).

3 The field conditions under which tests were made are carefully characterized (See Tables 1 and 2).

4 Coefficients of rolling resistance calculated on the basis of the load nearest the recommended capacity are given for the 23 wheels tested (See Fig. 7).

5 Although accurate comparisons between the rolling resistance of steel wheels and pneumatic tires can be made only for specific wheels and conditions, summary comparisons of three pairs of steel wheels and tires are given for the nine operating conditions. At the recommended loads the mean reduction in rolling resistance resulting from the use of pneumatic tires was 28 per cent (See Table 5).

6 From the standpoint of rolling resistance at low speeds pneumatic tires were least efficient on concrete, where they increased the rolling resistance at recommended loads by 20 per cent. They were relatively most effective on rough surfaces or soil where the supporting strength of the soil approached the inflation pressure of the tire, such as a field road across fall plowing, where they reduced the rolling resistance by 46 per cent.

7 In general the percentage reduction in rolling resistance resulting from the use of pneumatic tires was greater at larger loads.

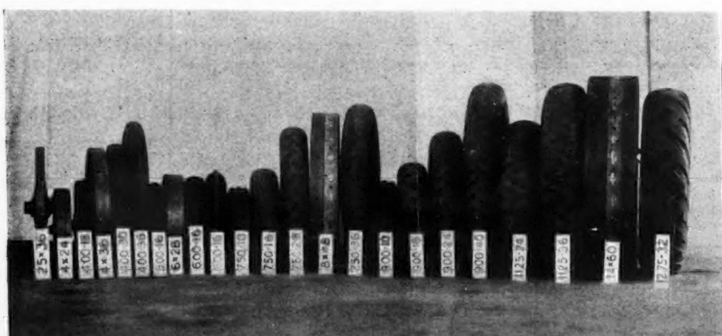
8 For certain conditions the relationship between load and rolling resistance is a compound curve rather than a straight line or even a simple curve (See Fig. 8).

*Wheels.* The twenty-three wheels used are shown in Fig. 1, arranged according to increasing width and diameter. For the steel wheels the size varied from 4x24 to 14x60 in and for the pneumatic tires, from 4.00-18 to 12.75-32 in.

*Road and Field Conditions.* All wheels were tested at several loads under four operating conditions, namely, concrete, bluegrass pasture, tilled loam, and loose sand. These conditions are described under A, B, C, and D of Tables 1

Journal paper No. J-707 of the Iowa Agricultural Experiment Station. Project No. 576, in cooperation with the American Society of Agricultural Engineers.

The authors are, respectively, associate professor of agricultural engineering, and professor and head of the department of agricultural engineering, Iowa State College.



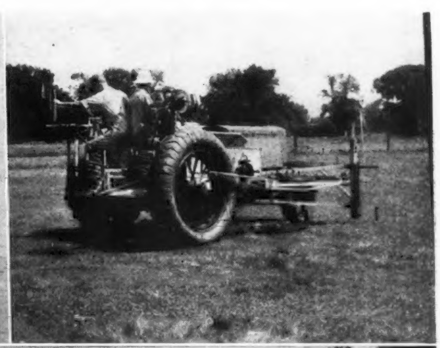


FIG. 1 (UPPER LEFT) THE 23 WHEELS, 6 STEEL AND 17 PNEUMATIC, ARRANGED ACCORDING TO INCREASING WIDTH AND DIAMETER. FIG. 2 (UPPER RIGHT) FIELD B, BLUEGRASS PASTURE. (SEE TABLES 1 AND 2, AND FIG. 5). FIG. 3 (LOWER LEFT) FIELD C, TILLED LOAM. (SEE TABLES 1 AND 2, AND FIG. 5). FIG. 4 (LOWER RIGHT) FIELD D, LOOSE SAND. (SEE TABLES 1 AND 2, AND FIG. 5)

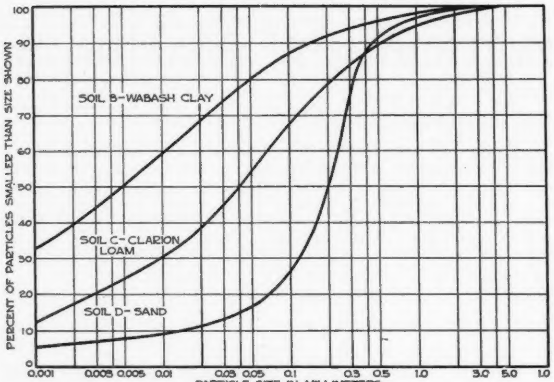



FIG. 5 GRAIN DIAMETER ACCUMULATION CURVES FOR THE SOILS OF FIELDS B, C, AND D. (SEE TABLES 1 AND 2, AND FIGS. 2, 3, AND 4)

and 2, and are pictured in Figs. 2, 3, and 4. The soil textures for fields B, C, and D are given in detail in Fig. 5.

Eight of the wheels, four steel and four pneumatic, were tested under five winter and early spring field conditions, including snow and mud. These conditions are described in Table 1 under sections E to J.

*Test Equipment.* The equipment used for determining rolling resistance and rolling diameter[1] is shown in operation by Figs. 2, 3, and 4 and in detail by Fig. 6. In planning this apparatus the objective was to obtain a maximum number of accurate individual tests on a minimum area in the shortest practicable time. A chain hoist facilitated wheel changes and easily adjusted controls enabled the operator to maintain a level position of the test frame. Accurate grade determinations were obtained by means of an elevation gauge and hinged stakes (See Fig. 3).

The test wheel was mounted on a live axle which in turn was carried on ball bearings. Thus all wheels were tested with the same bearings. The use of spacers allowed the test of any wheel width up to 20 in. Vertical adjustment, provided at the test frame hitch, right front, and at the rear left frame support were sufficient to accommodate test wheels varying from 20 to 60 in in diameter.

[1]These results are to be presented in a later paper.

TABLE I. ROAD AND FIELD CONDITIONS ON WHICH THE ROLLING RESISTANCE DATA GIVEN IN TABLES 3 AND 4 WERE OBTAINED

A Concrete

B Bluegrass pasture (See Table 2 and Figs. 2 and 5).

C Freshly tilled loam, sweet clover stubble plowed 10 in deep, using a single-bottom 18-in plow with section of spike tooth harrow attached (See Table 2 and Figs. 3 and 5).

D Loose sand tilled in the same way as C. (See Table 2 and Figs. 4 and 5).

E Frozen cornstalk field covered with 1 to 3 in of snow, sleet, ice.

F Temporary field road across fall-plowed loam; tests made in March; Iowa penetrometer, 1.4 in; moisture, 27 per cent; and weight per cubic foot, 74 lb. Moisture and weight calculated on dry basis.

G Deep loose snow, 10 to 14 in, on frozen sweet clover stubble.

H Fall-plowed loam; plowed 8 in deep in October; tests made in March soon after thawing to depth of 12 in; Iowa penetrometer, 4.0 in; moisture 22 per cent; weight per cubic foot, 68 lb.

J Settled tilled loam, tilled in November the same way as C, tests run in March; Iowa penetrometer, 3.4 in; moisture, 24 per cent; weight per cubic foot, 67 lb.

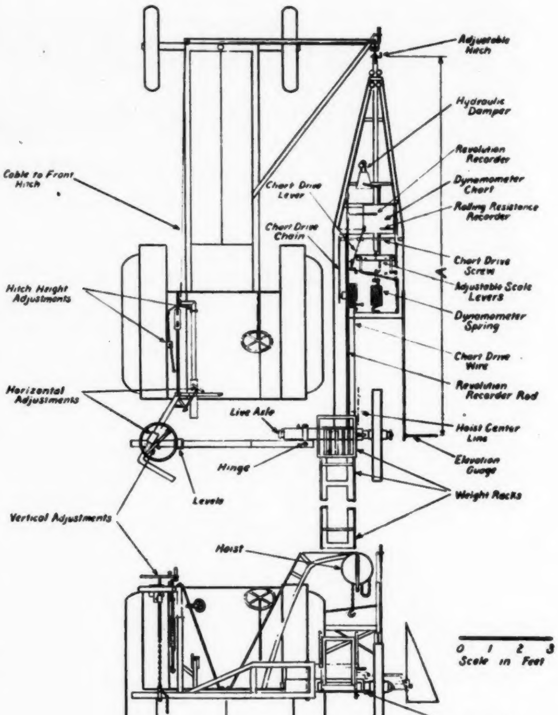



FIG. 6 APPARATUS USED TO DETERMINE THE ROLLING RESISTANCE AND ROLLING CIRCUMFERENCE OF INDIVIDUAL TRANSPORT WHEELS

*Loads.* By the use of removable weights it was possible to adjust the gross load from a minimum of about 400 lb, depending on the weight of the wheel, to a maximum of 2000 lb. The gross loads used were 500, 1000, 1500, and

TABLE 2. SOIL CONDITIONS[a] ON WHICH THE ROLLING RESISTANCE DATA GIVEN IN TABLE 3 AND FIG. 7 WERE OBTAINED

| Series | B[a] | C[a] | D[a] |
|---|---|---|---|
| Texture | Wabash clay | Clarion loam | Unclassified sand |
| Lower liquid limit[b] | 59 | 34 | c |
| Lower plastic limit[b] | 25 | 22 | c |
| Plastic index[b] | 34 | 12 | c |
| Lineal shrinkage[d], per cent | 20 | 7 | 0 |
| Moisture[e], per cent | 22 | 18 | 8 |
| Weight[e] per cubic foot, lb | 67 | 62 | 83 |
| Iowa penetrometer[f], in | 0.5 | 6.4 | 6.8 |
| Stone penetrometer[g], in | 2.4 | 11.6 | 11.0 |
| Proctor soil pacticity needle[h], lb per sq in | 1000 | 28 | 26 |

[a]B, bluegrass pasture; C, freshly tilled loam; D, river bottom, 30 inches of sand underlaid with clay (See Table 1 and Figs. 2, 3, and 4).

[b]American Association of State Highway Officials. Standard specifications for highway materials and methods of sampling and testing. p. 221-243. The Association, Washington. 1935.

[c]Non-plastic.

[d]Newman, F. H. Soil stabilization. Roads and Streets, V. 81, No. 9, p. 44-46. 1938.

[e]At time of tests; calculated on the dry basis.

[f]Page 349, Res. Bul. 231, Iowa Agrl. Exp. Sta. 1938.

[g]Stone, A. A. and Williams, Ira L. Measurement of soil hardness. AGRICULTURAL ENGINEERING 20: 25-26. 1939.

[h]Proctor, R. R. Description of field and laboratory methods. Engineering News-Record 111: 286-289. 1933.

TABLE 3. ROLLING RESISTANCE IN POUNDS[a] OF TWENTY-THREE INDIVIDUAL WHEELS ON FOUR ROAD AND FIELD CONDITIONS AT TWO OR THREE DIFFERENT LOADS[b]

| | | 500-lb load | | | | | 1000-lb load | | | | | 1500-lb load | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Field[d] | | | | | Field[d] | | | | | Field[d] | | | |
| Wheel[c] | Ply | Pressure | A | B | C | D | Pressure | A | B | C | D | Pressure | A | B | C | D |
| 2.5x36 | S[e] | S[e] | 7 | 33 | 173 | 201 | S[3] | 10 | 87 | 384 | 431 | S[e] | 15 | 173 | 583 | 688 |
| 4x24 | S | S | 17 | 41 | 234 | 252 | S | 24 | 95 | 504 | 602 | S | 34 | 183 | — | — |
| 4.00-18[h] | 4 | 20 | 17 | 29 | 183 | 196 | 44 | 30 | 70 | — | — | | — | — | — | — |
| 4x36 | S | S | 11 | 28 | 156 | 178 | S | 19 | 74 | 367 | 413 | S | 24 | — | — | — |
| 4.00-30 | 4 | 16 | 12 | 25 | 143 | 139 | 36 | 18 | 57 | 322 | 319 | | — | — | — | — |
| 4.00-36 | 4 | 16 | 11 | 22 | 131 | 130 | 36 | 17 | 50 | 294 | 277 | | — | — | — | — |
| 5.00-16 | 4 | 16 | 19 | 26 | 171 | 179 | 32 | 31 | 62 | 388 | 460 | | — | — | — | — |
| 6x28 | 4 | S | 13 | 38 | 131 | 161 | S | 23 | 94 | 368 | 477 | S | 31 | 141 | 640 | 811 |
| 6.00-16[h] | 4 | 16 | 17 | 28 | 150 | 143 | 20 | 27 | 60 | 319 | 338 | 40 | 32 | 90 | 532 | 626 |
| 6.00-16[f] | 4 | 20 | 17 | 33 | 174 | 165 | 30 | 31 | 70 | 401 | 397 | | — | — | — | — |
| 7.50-10 | 4 | 16 | 19 | 27 | 152 | 181 | 20 | 29 | 61 | 379 | 429 | 32 | 38 | 96 | 593 | 714 |
| 7.50-16 | 4 | 16 | 11 | 25 | 134 | 136 | 16 | 25 | 54 | 268 | 293 | 20 | 38 | 82 | 420 | 483 |
| 7.50-28 | 4 | 16 | 14 | 26 | 102 | 107 | 16 | 23 | 55 | 208 | 207 | 16 | 39 | 78 | 296 | 308 |
| 8x48[g] | S | S | 7 | 37 | 107 | 101 | S | 14 | 80 | 213 | 193 | S | 19 | 97 | 354 | 396 |
| 7.50-36 | 4 | 16 | 10 | 24 | 91 | 87 | 16 | 18 | 49 | 197 | 188 | 16 | 27 | 69 | 278 | 266 |
| 9.00-10 | 4 | 16 | 17 | 28 | 139 | 154 | 20 | 31 | 60 | 331 | 388 | 32 | 44 | 97 | 478 | 646 |
| 9.00-16 | 6 | 16 | 17 | 28 | 135 | 125 | 16 | 38 | 61 | 269 | 281 | 16 | 63 | 81 | 374 | 408 |
| 9.00-24 | 4 | 16 | 12 | 27 | 99 | 98 | 16 | 23 | 53 | 199 | 201 | 16 | 35 | 79 | 279 | 309 |
| | | 1000-lb load | | | | | 1500-lb load | | | | | 2000-lb load | | | | |
| 9.00-40 | 6 | 16 | 18 | 52 | 170 | 174 | 16 | 28 | 64 | 238 | 251 | 16 | 36 | 73 | 336 | 318 |
| 11.25-24 | 4 | 16 | 14 | 56 | 185 | 194 | 16 | 22 | 80 | 260 | 277 | 16 | 38 | 89 | 366 | 353 |
| 11.25-36 | 6 | 16 | 15 | 51 | 167 | 179 | 16 | 21 | 72 | 234 | 258 | 16 | 31 | 74 | 336 | 324 |
| 14x60[g] | S | S | 13 | 65 | 177 | 158 | S | 16 | 84 | 256 | 272 | S | 23 | 112 | 372 | 354 |
| 12.75-32 | 8 | 16 | 19 | 53 | 176 | 162 | 16 | 26 | 64 | 251 | 250 | 16 | 35 | 80 | 365 | 322 |

[a]Each value is the mean of three non-consecutive trials; the pooled standard errors of these means for soils A, B, C, and D are 2.1, 2.7, 5.6 and 10.8 pounds respectively.

[b]Because of limitations of testing equipment the largest loads used were only one-third to one-half of the recommended capacities of the larger tires.

[c]See Fig. 1 for tread design.

[d]A, concrete; B, bluegrass pasture; C, freshly tilled loam; D, loose sand. See Tables 1 and 2 and Figs. 2, 3, and 4 for more complete description of B, C, and D.

[e]Steel wheels. [f]Skid ring tractor tire.

[g]Tests on concrete of the 48 and 60-in steel wheels were run with 4-in rim width.

[h]Recommended maximum capacities for 4-ply 4.00-18 and 6.00-16 tires are only 770 and 1240 lb respectively.

2000 lb (See Tables 3 and 4). Unfortunately even the 2000-lb load was only one-third to one-half of the recommended capacity of the five larger tires.

*Inflation Pressures.* The recommendations of the Tire and Rim Association with respect to inflation pressures were followed, except where the load was below the range of their published tables. In such instances an arbitrary pressure of 16 lb per square inch was used. The pressures used for each tire and load are given in Tables 3 and 4.

*Speed.* Previous studies[2] have shown that varying speed within the field operating range, up to about 5 mph, has no important effect on the relative rolling resistance of transport wheels. All rolling resistance tests were made, therefore, at a speed of 2 mph. The use of this conservative speed minimized the problems of equipment maintenance

[2]Research Bulletin No. 231. Iowa Agr'l Exp. Sta. 1938, and McCuen, G. W. and Silver, E. A. Rubber-tired equipment for farm machinery. Bul. 556, Ohio Agrl. Exp. Sta. 1935.

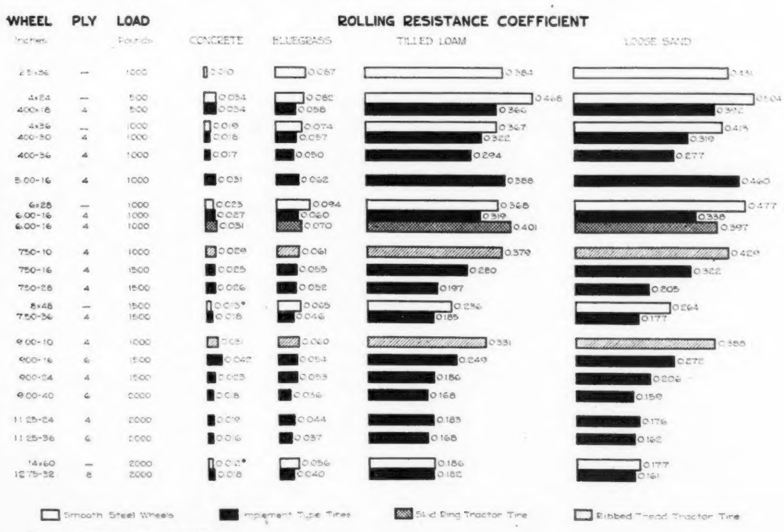
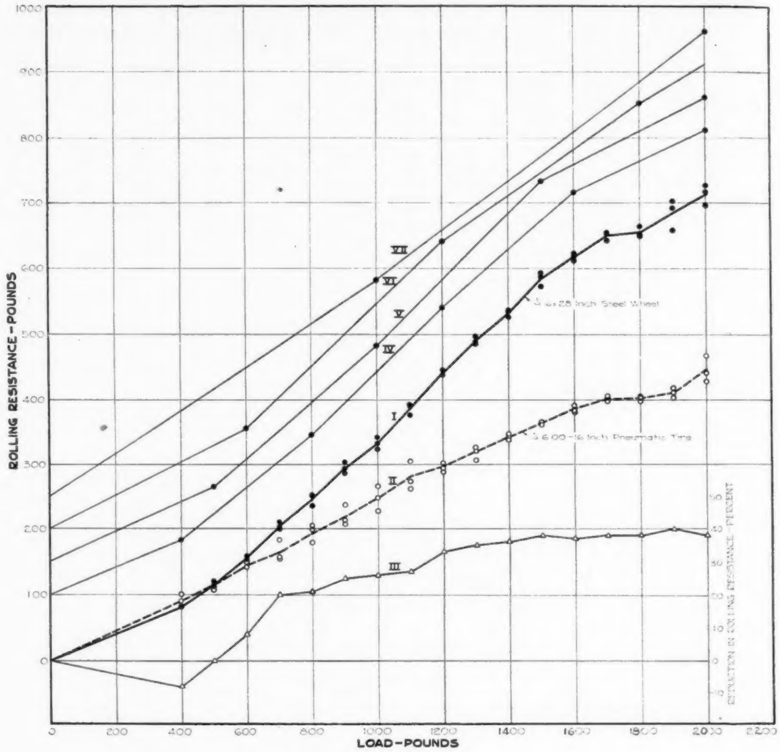



FIG. 7 COEFFICIENTS OF ROLLING RESISTANCE CALCULATED FROM THE DATA OF TABLE 3. THE LOADS SELECTED ARE THOSE NEAREST TO THE RECOMMENDED CAPACITIES. IT SHOULD BE NOTED, HOWEVER, THAT BECAUSE OF TESTING EQUIPMENT LIMITATIONS THESE LOADS REPRESENT ONLY ONE-THIRD TO ONE-HALF OF THE CAPACITIES OF THE 9.00-24 AND LARGER TIRES

FIG. 8 ROLLING RESISTANCE OF 6x28-IN STEEL WHEEL AND 6.00-16 PNEUMATIC TIRE ON A PLOWED LOAM FIELD. GRAPHS IV, V, VI AND VII ARE DISPLACED UPWARD 100, 150, 200, AND 250 LB, RESPECTIVELY, AND REPRESENT THE RESULTS WHICH WOULD HAVE BEEN OBTAINED IF TESTS HAD BEEN MADE AT 400, 500, 600, AND 1000-LB LOAD INTERVALS INSTEAD OF AT THE 100-LB INTERVALS SHOWN IN GRAPH I. TESTS AT 1300 LB AND ABOVE EXCEED THE RECOMMENDED CAPACITY OF A FOUR-PLY 6.00-16 TIRE




and permitted a 50-ft test at uniform speed to be made in a shorter total distance.

*Rolling Resistance.* The results of rolling resistance tests of 23 wheels on concrete and the three field conditions shown in Figs. 2, 3, and 4 are given in Table 3. Three loads were used for all except six of the smaller wheels, which were tested at only two loads. Each rolling resistance value given is the mean of three nonconsecutive trials. The pooled standard errors of these means for tests on concrete, bluegrass, tilled loam, and loose sand, respectively, are 2.1, 2.7, 5.6, and 10.8 lb.

The results of similar tests of eight selected wheels under five winter and early spring field conditions are given in Table 4. These tests were limited to one load for each wheel because of the difficult and rapidly changing field conditions.

*Coefficient of Rolling Resistance.* Coefficients calculated from the data of Table 3 are listed numerically and shown graphically in Fig. 7. These coefficients were obtained by dividing the rolling resistance at a selected load by the load. The selection of loads was based on the recommended tire capacities.

In this figure the steel wheels are paired with the pneumatic tires having similar dimensions and the tires are arranged in groups having the same cross section. The effectiveness of diameter as a means of reducing rolling resistance for all conditions is evident, as is also the relative advantage of pneumatic tires except on concrete.

*Relative Rolling Resistance of Steel Wheels and Pneumatic Tires.* If rolling resistance comparisons between steel wheels and pneumatic tires are to be highly accurate they must be made on the basis of a specific wheel and tire operated under specified conditions. From the standpoint of simplification, however, there is some justification for summarizing on the basis of comparisons between steel wheels and pneumatic tires of approximately the same dimensions. Such a summary for three pairs of wheels tested on nine road and field conditions is given in Table 5, in which these nine road conditions are listed in the order of increasing rolling resistance.

In analyzing these comparisons it is well to keep in mind that, from the standpoint of rolling resistance at low speeds, the principal advantages of the pneumatic tire are (1) that it accommodates itself to hard surface irregularities, and (2) that it ceases to displace soil as soon as the

TABLE 4. ROLLING RESISTANCE[a] OF FOUR STEEL AND FOUR PNEUMATIC WHEELS ON WINTER AND EARLY SPRING FIELD CONDITIONS

| Pairs | Wheels[b] | Load lb | Inflation, lb/sq in | Field conditions[c] E | F | G | H | J |
|---|---|---|---|---|---|---|---|---|
| 1 | 4x24 | 500 | Steel | 50 | 84 | 141 | 123 | 156 |
| | 4.00-18 | 500 | 20 | 38 | 56 | 105 | 107 | 128 |
| 2 | 6x28 | 1000 | Steel | — | 166 | 156 | 225 | 357 |
| | 6.00-16 | 1000 | 20 | 53 | 87 | 146 | 161 | 271 |
| 3 | 8x48 | 1500 | Steel | 64 | 154 | 178 | 212 | 321 |
| | 7.50x36 | 1500 | 16 | 53 | 66 | 113 | 108 | 230 |
| 4 | 2.5x36 | 1000 | Steel | — | 183 | 106 | 234 | 407 |
| | 9.00-16 | 1500 | 16 | 64 | 105 | 149 | 157 | 359 |

[a]Figures given are the mean of three trials except for field condition E where only two trials were made.

[b]For the first three pairs the over-all dimensions of the steel and pneumatic wheels are approximately the same. The last two wheels were chosen to obtain information on a high narrow steel wheel and on a pneumatic wheel with large cross-section. The dimensions of these wheels are, of course, not comparable.

[c]E, frozen cornstalk field; F, temporary field road; G, deep loose snow; H, fall-plowed loam; J, settled tilled loam. See Table 1 for more complete description of these field conditions.

TABLE 5. REDUCTION IN ROLLING RESISTANCE[a] FROM THREE STEEL WHEELS TO PNEUMATIC TIRES OF SIMILAR DIMENSIONS

| Road and field conditions[b] | Load lb | 4x24 steel to 4.00-18 pneumatic lb | 4x24 steel to 4.00-18 pneumatic per cent | 6x28 steel to 6.00-16 pneumatic lb | 6x28 steel to 6.00-16 pneumatic per cent | 8x48 steel to 7.50-36 pneumatic lb | 8x48 steel to 7.50-36 pneumatic per cent | Mean per cent for All loads | Mean per cent for Selected loads[c] |
|---|---|---|---|---|---|---|---|---|---|
| A — Concrete | 500 | 0 | 0 | –4 | –31 | –3 | –43 | | |
| | 1000 | –6 | –25 | –4 | –17 | –4 | –28 | | |
| | 1500 | | | –1 | – 3 | –8 | –42 | –24 | –20 |
| E — Frozen cornstalk field | 500 | 12 | 24 | | | | | | |
| | 1500 | | | | | 11 | 17 | 20 | 20 |
| B — Bluegrass pasture | 500 | 12 | 29 | 10 | 26 | 13 | 35 | | |
| | 1000 | 25 | 26 | 34 | 36 | 31 | 39 | | |
| | 1500 | | | 51 | 36 | 28 | 29 | 32 | 31 |
| F — Temporary field road | 500 | 28 | 33 | | | | | | |
| | 1000 | | | 79 | 48 | | | | |
| | 1500 | | | | | 88 | 57 | 46 | 46 |
| G — Deep, loose snow | 500 | 36 | 26 | | | | | | |
| | 1000 | | | 10 | 6 | | | | |
| | 1500 | | | | | 65 | 37 | 23 | 23 |
| H — Fall-plowed loam | 500 | 16 | 13 | | | | | | |
| | 1000 | | | 64 | 28 | | | | |
| | 1500 | | | | | 104 | 49 | 30 | 30 |
| J — Settled tilled loam | 500 | 28 | 18 | | | | | | |
| | 1000 | | | 86 | 24 | | | | |
| | 1500 | | | | | 91 | 28 | 23 | 23 |
| C — Freshly tilled loam | 500 | 51 | 22 | –19 | –15 | 16 | 15 | | |
| | 1000 | | | 49 | 13 | 16 | 8 | | |
| | 1500 | | | 108 | 17 | 76 | 21 | 12 | 19 |
| D — Loose sand | 500 | 56 | 22 | 18 | 11 | 14 | 14 | | |
| | 1000 | | | 139 | 29 | 5 | 3 | | |
| | 1500 | | | 185 | 23 | 130 | 33 | 19 | 28 |
| Mean, exclusive of concrete | | | | | | | | | |
| All loads | | | 24 | | 22 | | 28 | 25 | |
| Selected loads[c] | | | 23 | | 26 | | 34 | | 28 |

[a]Calculated from data given in Tables 3 and 4.

[b]See Tables 1 and 2 for more complete descriptions. In this table the soil conditions are listed in the order of increasing rolling resistance.

[c]500, 1000, and 1500 lb respectively, for the first, second, and third pairs. These loads are selected because they are nearest the recommended capacities.

soil has been compacted to the point where its supporting strength is slightly above the inflation pressure of the tire. On the other hand, pneumatic tires have the disadvantage that energy is lost as a result of flexing.

Thus, at low speeds on a hard smooth surface, the rolling resistance advantages disappear. The comparisons of Table 5 show an average increase in rolling resistance of 24 per cent on concrete. Opposed to this increase is the 46 per cent decrease obtained on a temporary field road where the supporting strength of the soil was just sufficient to prevent appreciable displacement by pneumatic tires, particularly the larger tires operated at lower inflation pressures.

In general, the proportionate gain from the use of pneumatic tires increased with increased loads, although there were important exceptions. For the second and third pairs of wheels and those soil conditions where tests were made at three loads, the mean reduction in rolling resistance resulting from the use of tires was 14, 21, and 26 per cent, respectively, at 500, 1000 and 1500-lb loads.

If only the recommended loads are included, the mean reduction for the eight field conditions is 28 per cent. This is considerably less than the 44 per cent given in the previous report on the rolling resistance of manure spreaders[3]. The difference is probably caused by the following: The rear wheels of the steel-wheeled spreader were equipped with cleats, the steel wheels used on the spreader were narrower than the pneumatic tires used, the road and soil conditions used in the spreader tests may have been somewhat more favorable to pneumatic tires, and for the soil conditions used, the gain from tandem arrangement may have been relatively greater for the pneumatic tires.

*Interaction of Factors Affecting Rolling Resistance.* The rather wide and somewhat unsystematic variation in the percentage reductions shown in Table 5 is probably the result of the interaction of the large number of factors which determine the rolling resistance of a transport wheel. Among such factors are soil texture, structure (including tilth and vegetation), and moisture. Variations in these soil factors from the surface downward are also important. Wheels and tire differences such as diameter, width, tire wall thickness, and inflation pressure introduce further complications.

The problem is made still more difficult by the fact that under some conditions the effects of certain of these factors are reversed. For example, increasing the inflation pressure lowers the rolling resistance on a hard smooth surface and increases it in loose sand. The effects of changing certain other factors pass through minima or maxima. Thus, for certain combinations of wheel and field conditions, the relation of load and rolling resistance is a compound curve rather than a straight line or even a simple curve.

Graph I of Fig. 8 shows such a compound curve for a 6x28-in steel wheel on a plowed loam field. This curve was obtained by repeating three times a series of tests with loads ranging from 400 to 2000 lb at intervals of 100 lb. Graph II represents a similar set of tests for a 6.00-16-in tire operated at 30-lb per square inch inflation pressure on the same field. Graph III shows the resulting percentage reduction from the rolling resistance of the steel wheel. This reduction varies from –8 per cent at a 400-lb load to 40 per cent at the 1900-lb load.

Graphs IV, V, VI, and VII show the type of curves which would have resulted if tests had been made at 400, 500, 600, or 1000-lb load intervals, respectively, rather than at the 100-lb intervals used to obtain Graph I. Since the load at which the load-rolling resistance graph inflects varies with changing wheel and soil characteristics, this phenomenon explains in part the frequent failure to obtain parallel graphs when investigating the rolling resistance of a group of transport wheels.

ACKNOWLEDGMENTS: The authors wish to acknowledge the assistance of research fellows H. J. Thompson, R. L. Green, and D. O. Hull.

[3]McKibben, E. G. and Thompson, H. J. Transport wheels for agricultural machines—I. Comparative performance of steel wheels and pneumatic tires on two manure spreaders of the same model. AGRICULTURAL ENGINEERING 20:419-422 (November 1939).

# Development of Irrigation Projects in Saskatchewan

By G. N. Denike
MEMBER A.S.A.E.

SASKATCHEWAN is located in the heart of the drought area. During the past eight years, problems have developed which are similar to those in the western United States. A special administrative federal government agency was set up in 1935 to meet the emergent problems, authorized by the Prairie Farm Rehabilitation Act. The work is being carried out by the Dominion Department of Agriculture under the experimental farms service. Emergency appropriations have enabled this service to cope with the problems, through its stations, with experienced officers and additional trained staff.

Utilization of all available water resources for purposes of providing reserve feed for livestock, stock-watering, and domestic use, as well as insuring garden truck for local consumption, is a major objective of the work undertaken. Irrigation development for private use and for resettlement has been an important phase of the rehabilitation program.

Irrigation has been practised in Saskatchewan by private individuals for over 40 years on a scale varying from only a few to as many as 600 acres. Most of these private schemes are located in the ranching area of the southwest and used to provide reserve winter feed for livestock. Practically all the older systems were of the diversion and flood type, making use of one spring flooding on natural hay crops. A few storage and ditch systems were established which are still in good working order.

Saskatchewan's western boundary is situated 100 to 150 miles east of the Rocky Mountain foothills. All mountain waters draining through the province are carried in rivers with beds 50 to 100 ft below the surrounding land levels. Rough river "breaks" and channels make water storages costly and uneconomic at the present time. Usable water for irrigation purposes is confined to shallow rivers draining local areas within the province. The size and type of irrigation projects which may, at present, be economically undertaken are confined to those of moderate size located along wide river bottoms. Two main types of projects are being undertaken under the P.F.R.A., namely, small private schemes located in drainage channels where a small amount of land may be easily served, and larger community or resettlement projects along streams of more certain water supply and near large blocks of irrigable land.

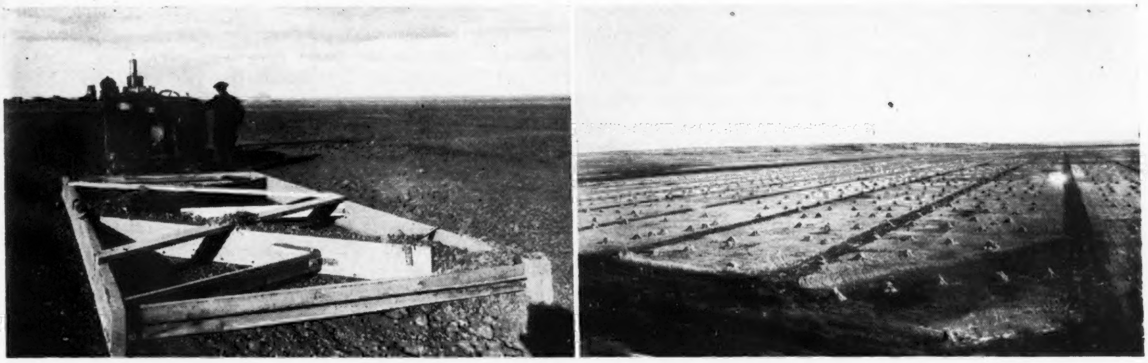
The governmental policy of water and irrigation development includes a small amount of financial assistance for small private schemes. All engineering services are provided by government engineers. Schemes must be surveyed, constructed, and licensed in accordance with regulations set down by the government before any aid is granted. Proper design, construction, and water use is assured in this manner. A follow-up program is carried out by agricultural engineers and agronomists on all private projects to aid the user in laying out his supply system, and preparing and levelling his land. Expert assistance and advice on crops, rotations, tillage practice, and water application is given.

Larger scale developments undertaken under the P.F.R.A. are confined to those projects designed to re-establish farmers from marginal and submarginal lands. Forced abandonment of such lands has left many families as a national charge. The development of irrigation projects in conjunction with large tracts of adjacent grazing lands offers a natural re-establishment opportunity for many of these individuals. All such projects differ from the large commercial irrigation districts in that no effort is made to provide the settler with sufficient land to maintain his liveli hood on commercial crops. The absence of markets such as large urban centers, canning and sugar factories or the like precludes the production of high-value crops. Production must be confined, of necessity, to those crops which cannot be more economically produced on the nearby dry lands. Grain growing for cash is automatically excluded as a major crop. Use of the large controlled grazing areas with a parcel of irrigated land to insure garden truck, seed supplies, and feed makes it imperative that the cash crop be livestock. In one or two cases larger developments are located in the heart of large grain-growing areas where the type of farming and rainfall makes feed supplies for stock and garden produce a very uncertain factor.

Resettlement irrigation developments under the P.F.R.A.

(LEFT) HEAVY TIMBER FLOATS ROUGHING DOWN LAND AFTER PLOWING. (RIGHT) A TYPE OF LEVELER USED IN FINISHING

Presented before the Soil and Water Conservation Division at the annual meeting of the American Society of Agricultural Engineers at St. Paul, Minn., June 21, 1939. The author is assistant superintendent of the Dominion Experiment Station at Swift Current, Sask., Canada.



(LEFT) A HOMEMADE LEVELER FOR MAINTENANCE WORK AFTER COMPLETION OF THE INITIAL LEVELLING. (RIGHT) BORDER DITCHES ARE USED DURING THE TEST YEAR, LEVELLED-IN FOR HARVESTING AND RELEVELLING OPERATIONS

are government undertakings from survey to settlement. The federal government requires control of all lands involved in the project. Land is purchased from owners at a fixed price under agreement to resell a given portion after development to those who wish to remain. This resale price is equal to the original cost plus the average per acre cost of development. Parcels of developed land are sold to reestablished settlers at a fixed price per acre.

Preliminary topographic and hydrometric surveys are made by the engineers of the water development branch of the P.F.R.A. Possibilities of storage, water available, and land are determined from these surveys. Surveys of land development, supply systems, and drainage are made by the agricultural engineers. Resettlement surveys are conducted by the agriculturist who will become project manager after development. All three surveys are conducted at the same time to expedite the work and secure the essential information for approval or rejection of the project. Following approval, all three phases of development commence work at the same time in an effort to collaborate for best development of the project.

Problems of land development on this type of project tax the best training of the agricultural engineer. The type of application system, volume of supply, grades, soil types, crops to be grown, rotations used, and drainage necessary require a thorough working knowledge of applied engineering and agriculture. Special problems of structural design and system planning must be worked out with a thorough understanding of their ultimate, long-time use by one who has special training along this line. The agricultural engineer should be well equipped with the theoretic background upon which to build such a knowledge with practical experience.

The lack of precedent in the form of older, established irrigation projects works a handicap on those developing and settling the projects under discussion. The farmers who, of necessity, must settle these projects, are drawn from the immediate vicinity of the development. Dry-land grain farming tends to develop habits opposite to those required on irrigation. Necessity has forced the people who will settle these projects to make the change. Selection of settlers will not be possible except by a process of elimination which will take many years. These projects must be designed and constructed to take care of settlers who have no resources and must start from scratch.

Past experience on the older and larger irrigation developments proved that enough money was necessary to tide the settler over the first year or two. Rough land spelled disaster to those without resources to level it. Those on smooth, level land with good drainage made steady progress. On the Saskatchewan developments we must assume that the settler has willingness and good heart but has no means and little knowledge of what he is attempting.

With this basis to work on, the agricultural engineer in charge of land preparation must design and develop a system of water application which is next to automatic. He must prepare the land in such a way as to leave the minimum of nonirrigable land in any parcel. Structures must be of such a nature as to require minimum care, operation, and replacement. The drainage system must have both capacity and protection against any possible contingency. In all cases the preservation of the soil against erosion and the maximum use of water with minimum waste is essential.

All developments undertaken in Saskatchewan are of the free-flooding type from open ditches supplied from storage by gravity or centrifugal pump. The design and construction of supply systems, together with types of checks, drops, weirs, gates, flumes, syphons, and spillways present major problems in themselves, but for the most part it has been found expedient to use "tried and true" formulas until such time as individual difficulties arise.

The introduction of efficient modern dirt-moving and land-levelling equipment has materially altered land preparation methods for the application of free-flood irrigation water. On three of the major resettlement projects undertaken to date, final planetable surveys show an increase of over 15 per cent in the irrigable area by the elimination of high spots, low draws, or rough land. Many areas indicated as "not suitable" in the original surveys have been made with modern equipment, into very desirable parcels. From a land-use standpoint the elimination of non-irrigable areas within a single parcel increases the use of water, reduces waste water, and results in a sharp improvement in crop yield and weed control. The elimination of these areas affects materially the design of the supply system and duty of water and is a considerable factor in the total development and resettlement program.

Use of heavy, modern dirt-moving equipment for land levelling, without the complications of survey boundary lines or supply ditches, greatly reduces the cost of adequate and thorough land preparation. On the Saskatchewan projects it has been possible to level large tracts on a bulk scale with large carry-all scrapers, bulldozers, graders, and rail and log floats at a cost which is only a small fraction of that formerly thought possible. It has been necessary, in cases where ditch surveys preceded levelling operations, to alter the supply system plans after levelling. In all cases final planetable plans show a maximum of irrigable area.

Many of the areas taken over for irrigation are covered with sage, buck brush, greasewood, willow, rosebush, or

native bluejoint. Specially constructed brush cutters which travel just below the crown roots, 2 to $2\frac{1}{2}$ in below the surface, cut the brush from these areas. Trailbuilder frames are used to mount these special cutters. Heavy rakes pile this surface trash into windrows where it is burned. Where high points or ridges must be removed and low spots or swales filled, the carry-all scrapers and bulldozers follow the removal of the thin scrub.

Shallow depressions or slight hummocks are disregarded until after plowing. Heavy double and triple timber floats of 16x16 or 16x24-in material 24 to 36 ft long are dragged over the plowed ground, roughing down all unevenness. Three heavy, 100-lb steel railroad irons fastened together by heavy shafting to secure a cutting tilt are used to put all but the finished levelling touches on most of this land. Those areas levelled with scrapers and bulldozers are treated in the same manner as new land after plowing. Several trips of the log and rail floats in cross directions fill in any surface roughness left by heavy equipment.

Automatic land levellers, of two or three types, are used to do the finish work. By concentrating on those small spots which may still be a few inches high or low, the entire area is left in a level condition.

### CHARACTER OF SOIL INFLUENCES LEVELLING PRACTICE

Soils of different textures and profiles must of necessity be treated by different methods. Deep soils will stand severe levelling operations. Shallow soils with undesirable or unproductive subsoil will not react favorably to large-scale, rough levelling. Soils of different texture and profile react differently under wet or dry conditions. The application of water to levelled land causes it to swell or settle, expand or contract. The repeated wetting and drying of irrigation and crop growth results in marked alteration of surface levels.

Results to date indicate that after the second year of levelling and irrigation the surface level remains relatively unchanged. However, systematic and thorough levelling by the irrigator after each major tillage operation will increase his efficiency in direct proportion. These results have established the policy of governmental operation or control of all resettlement projects until after at least the second major levelling.

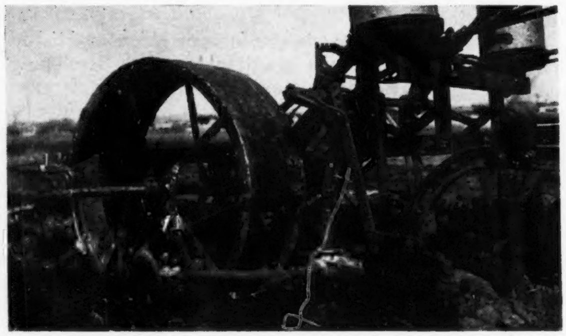
Following first levelling operations, the main supply system is constructed. Secondary and field supplies are established in a temporary fashion. After the test crop of spring grain has been seeded, grown and removed, the secondary and field ditches are filled in and the whole area relevelled. This second levelling is necessary to overcome the heaving and settling effects of the first irrigation. Permanent secondary and field supply ditches are established, after levelling, in accordance with resettlement plans. These plans are worked out by the project manager to fit individual needs, after considering the results of yields and water application during the test year. Legal subdivision into definite parcels may not take place until the project has been working for one or two years following settlement. Unforseen adjustments in boundaries, acreages, and water supplies may be arranged to fit changing needs during this period.

Establishment of farm access, roads, crossings, headgates, and deliveries is worked out with regard to the water-supply system, the farmstead location, access to market roads, and relation to stock trails to and from adjacent feed lots and grazing areas. The use of road ditches for drainage and the elimination of all possible "dead" right-of-way areas reduces project maintenance. The smooth finish of ditch banks, drainage ditch bottoms, borrow pits, and spoil banks makes possible the establishment and cutting of domestic hay crops for weed protection. Cost of project maintenance determines the annual water charge. Careful project planning to eliminate weed traps and provide maximum maintenance facilities will help reduce this charge.

It is difficult to quote figures and costs which may be comparable in all sections of the country. One example may serve to indicate the practical nature and sound financial investment of these resettlement irrigation projects. During 1938, the grain and feed returns from the first test crop on one project gave a return of 12.5 per cent on the capital investment, operating charges, and equipment used. These returns paid all operating costs for land levelling, ditching, water application, cropping and harvesting, as well as paying for most of the maintenance equipment. Possibly the bulk handling of the project area reduced costs too far below those expected on an individual settler basis, but the high rate of returns would indicate a safe basis for successful resettlement under sound, expert management.

Irrigation development in Saskatchewan is presenting many problems unique in this field from an agricultural as well as an engineering standpoint. The development of special tillage practices involves the design and alteration of equipment to fit these needs. New land preparation methods are being worked out under each changing condition. Agricultural engineers with a good background of soil and cultural training are making worthy contributions toward the solution of these problems. Soil erosion and drainage control are important factors on any irrigation development, and the solution of each individual problem must be worked out on the ground. A great field of investigation and research is just opening up and present indications are that the agricultural engineer is particularly well qualified to undertake this work.

Rehabilitation of Canadian agriculture, both on the prairie and elsewhere, involves a great combined problem for engineering and agricultural sciences. Special problems of water conservation and soil drifting control, drainage and irrigation practice, as well as seeding, tillage, harvesting and power are constantly arising. Ways and means must be found to allow agriculture to support a greater number of people in a better standard of living than ever before. The agricultural engineer, with his special training and ability, fits into the picture of rehabilitation as a logical aid to increase and preserve agricultural productivity.



A BASIN-FORMING ATTACHMENT DESIGNED TO REPLACE THE REAR WHEELS OF A NARROW-TREAD LISTER, BUILT AND TESTED BY LESTER LARSON, GRADUATE STUDENT IN AGRICULTURAL ENGINEERING, UNIVERSITY OF NEBRASKA

# NEWS

## Southern Section Meeting Announced

FOLLOWING recent custom, the yearly meeting of the Southern Section of the American Society of Agricultural Engineers will be held in conjunction with the meeting of the Association of Southern Agricultural Workers. The meeting in 1940 will be held February 7 to 9, at the Tutwiler Hotel, Birmingham, Ala. Agricultural engineering sessions are to be held in room 703.

According to the preliminary program, soil and water conservation subjects will be covered in the opening session, on the morning of February 7. A farm structures session is to be held during the afternoon of the same day. The morning of February 8 is to be devoted to rural electrification, and to a business meeting of the Section. The afternoon is left open for attendance at sessions of the Association of Southern Agricultural Workers. Farm Power and Machinery is scheduled for consideration on the morning of February 9.

Runoff studies and results, and the engineering in farm planning for soil and water conservation are to be covered in the opening session.

K. J. T. Ekblaw, president of the A.S.A.E. is to address the farm structures session, which will deal with the structures factor in a balanced southern agriculture, in tobacco curing, and in teaching and extension methods.

Rural electric progress will be considered from the standpoint of extension through 4-H Club work, college teaching, research, and activities of the rural service departments of power companies.

Subjects to be covered in the farm power and machinery session are farm mechanization, the farm implement business, plowing under legumes, and cotton ginning improvements.

Officers of the Section are A. Carnes, chairman; M. M. Johns, vice-chairman; and W. N. Danner, secretary.

## Washington News Letter

*from* AMERICAN ENGINEERING COUNCIL

### COMMITTEE HEARS CRITICISM OF CIVIL SERVICE

MANY suggestions for the improvement of the federal civil service were presented at a public hearing held November 1 and 2 in Washington by the President's Committee on Merit System Improvement, which is now preparing a report that is expected to recommend the inclusion of higher grades of professional employees within the classified civil service system, as well as other changes.

The committee, which is headed by Supreme Court Justice Stanley Reed, includes in its membership Gano Dunn and Gen. Robert E. Wood as representatives of the engineering professions and of business, respectively, as well as a number of high government officials. It was formed by President Roosevelt last February and has been studying the problem since that time. The submission of a final report is anticipated in the near future.

Of the many persons who presented testimony at the hearing only one, General Counsel D. W. Robinson, Jr., of the Federal Power Commission, opposed the further extension of the merit system. It was Mr. Robinson's contention that because of the peculiar requirements of his agency it could do a better job of selecting its legal staff than could the Civil Service Commission. All other witnesses supported the merit system in principle, but most of them submitted specific criticisms of the manner in which it is now functioning, and some recommended material modification of its procedure in recruiting employees for the more responsible positions. A representative of the Department of Agriculture, for example, suggested that its scientists and other experts be selected by joint boards made up from the Civil Service Commission, the Department itself, and one or more outside experts in the specific field involved.

Complaints directed at the administration of the present system may be briefly summarized as follows: Its examinations and lists are too general; too much time is consumed in the preparation of examinations, grading, and the compilation of eligible lists; registers are frequently too old; classification of jobs looks more to the number of subordinates controlled than to the real responsibilities of the position; present promotion and transfer procedure is inadequate; more attention should be paid to the training of employees for promotion. (Those who attended AEC's Annual Assembly last January will remember that at that time a representative of the Civil Service Commission recognized the validity of similar criticisms, but contended that their remedy was largely in the provision of more personnel and funds.)

Provisions of basic civil service law that came in for criticism included the state quota system and the preference granted to war veterans in grading applicants.

### PLAN PAN AMERICAN SCIENTIFIC MEETING

Preliminary plans for the eighth American Scientific Congress, to be held in Washington May 10 to 14, 1940, have been announced by the Department of State, following the dispatch of invitations to participate to the governments of all American republics affiliated with the Pan American Union. An organizing committee has already been named, headed by Under Secretary of State Sumner Welles and composed of a number of distinguished heads of scientific and governmental bodies, including Dr. C. G. Abbot and Dr. Alexander Wetmore of the Smithsonian Institution; Dr. Isaiah Bowman of Johns Hopkins University, Dr. Vannevar Bush of the Carnegie Institution, Dr. Ross G. Harrison of the National Research Council, Dr. James Brown Scott of the Carnegie Endowment for International Peace, and Dr. Leo S. Rowe of the Pan American Union.

At a recent meeting of this organizing committee it was decided to divide the Congress into eleven sections, each to be in charge of a chairman to be assisted by a vice-chairman and a section committee, which will soon be selected. The sections will cover, respectively, the anthropological sciences; the biological sciences; the geological sciences; agriculture and conservation; public health and medicine; physical and chemical sciences; statistics, history, and geography; international law, public law, and jurisprudence; economics and sociology; and education.

### ALASKA ROAD APPROVED

General approval as a "worthy and feasible" project has been given to the proposed international highway through British Columbia to connect the Pacific Northwest with Alaska, by a special commission appointed to review the project. A preliminary report to this effect has been transmitted to the Department of State by Representative Magnussen of Washington, chairman of the Commission. Definite recommendations as to route, cost, and method of financing have yet to be released.

### ARMS EMBARGO REPEALED

By amending the Neutrality Act that has since the outbreak of war in Europe imposed a mandatory embargo upon the export of arms, ammunition, and implements of war, Congress on November 3 started the United States along a new path in its efforts to avoid entanglement in that conflict.

In its revised form the statute now provides that whenever Congress or the President finds that a state of war exists between or among foreign states a proclamation shall be issued naming the nations involved. Thereafter, in general, it shall be unlawful (1) for American vessels to transport goods or passengers to any of the belligerent nations; (2) to export arms, ammunition, or implements of war to them unless title is transferred before the goods leave the United States; (3) for American citizens to travel on their vessels; (4) to extend any loans or credits to them or to their citizens. In addition, the President is empowered to proclaim combat zones where hostilities are actively being carried on, and it is thereafter unlawful for any American ship or citizen to enter the prescribed areas. Exemptions written into the law cushion its application to Canada and other nations within the Western Hemisphere, and also to countries technically at war but geographically remote from the scene of hostilities.

The theory behind the new law, as brought out during the debate in Congress, is that the United States is justified in voluntarily surrendering its traditional insistence upon the freedom of the seas for neutral vessels, and abandoning its trade with Europe for the duration of the war, in order to remove the irritation that, many believe, was primarily responsible for its entrance into the last European war, the sinking of American ships by bel- *(Continued on page 482)*

## ASAE Meetings Calendar

February 7-9, 1940—Southern Section, Tutwiler Hotel, Birmingham, Ala.


1939 Edition
Power Farming
INVENTORY
Yours for the Asking
● This booklet*, POWER FARMING INVENTORY, contains vital information, some of which is published for the first time. Never has all this information been available in such convenient form. Anyone concerned with the manufacturing, selling or purchasing of power farming equipment will find this booklet interesting. It's yours for the asking. Agricultural Division, Ethyl Gasoline Corporation, Chrysler Bldg., New York, N. Y.
* Prepared by the Research Department of Implement and Tractor.

## Distribution of Tractors on U. S. Farms By States and Counties

(Estimates based on statistical information available from official and trade sources. Estimates are as of July 1, 1939.)

### By States

| | |
|---|---|
| Alabama | 11,005 |
| Arizona | 5,307 |
| Arkansas | 14,666 |
| California | 66,727 |
| Colorado | 18,408 |
| Connecticut | 4,910 |
| Delaware | 3,695 |
| Florida | 10,929 |
| Georgia | 13,040 |
| Idaho | 9,325 |
| Illinois | 147,200 |
| Indiana | 87,441 |
| Iowa | 135,262 |
| Kansas | 98,506 |
| Kentucky | 12,818 |
| Louisiana | 12,510 |
| Maine | 5,253 |
| Maryland | 13,162 |
| Massachusetts | 6,415 |
| Michigan | 60,136 |
| Minnesota | |

### Arizona

| County | Tractors | County | Tractors |
|---|---|---|---|
| Apache | 33 | Navajo | 42 |
| Cochise | 96 | Pima | 222 |
| Coconino | 52 | Pinal | 456 |
| Gila | 27 | Santa Cruz | 48 |
| Graham | 200 | Yavapai | 129 |
| Greenlea | 8 | Yuma | 582 |
| Maricopa | 3,368 | | |
| Mohave | 44 | | 5,307 |

### Arkansas

| County | Tractors | County | Tractors |
|---|---|---|---|
| Arkansas | 2,955 | Lee | 326 |
| Ashley | 72 | Lincoln | 70 |
| Baxter | 20 | Little River | 76 |
| Benton | 634 | Logan | 82 |
| Boone | 57 | Lonoke | 972 |
| Bradley | 28 | Madison | 33 |
| Calhoun | 39 | Marion | 16 |
| Carroll | 108 | Miller | 114 |
| Chicot | 244 | Mississippi | 386 |
| Clark | 81 | Monroe | |
| Clay | | | |

| County | Tractors | County | Tractors |
|---|---|---|---|
| Lake | 4 | Pitkin | 18 |
| Larimer | 718 | Prowers | 397 |
| La Plata | 131 | Pueblo | 411 |
| Las Animas | 237 | Rio Blanco | 49 |
| Lincoln | 697 | Rio Grande | 345 |
| Logan | 1,043 | Routt | 140 |
| Mesa | 235 | Saguache | 161 |
| Mineral | 6 | San Juan | 14 |
| Moffat | 141 | San Miguel | 25 |
| Montezuma | 159 | Sedgwick | 511 |
| Montrose | 110 | Summit | 7 |
| Morgan | 607 | Teller | 25 |
| Otero | 238 | Washington | 862 |
| Ouray | 15 | Weld | 2,620 |
| Park | 24 | Yuma | 801 |
| Phillips | 704 | | 18,408 |

### Connecticut

| County | Tractors | County | Tractors |
|---|---|---|---|
| Fairfield | 572 | New London | 502 |
| Hartford | 1,325 | Tolland | |
| Litchfield | | | |

# INDEX
## to Power Farming Inventory 1939 Edition



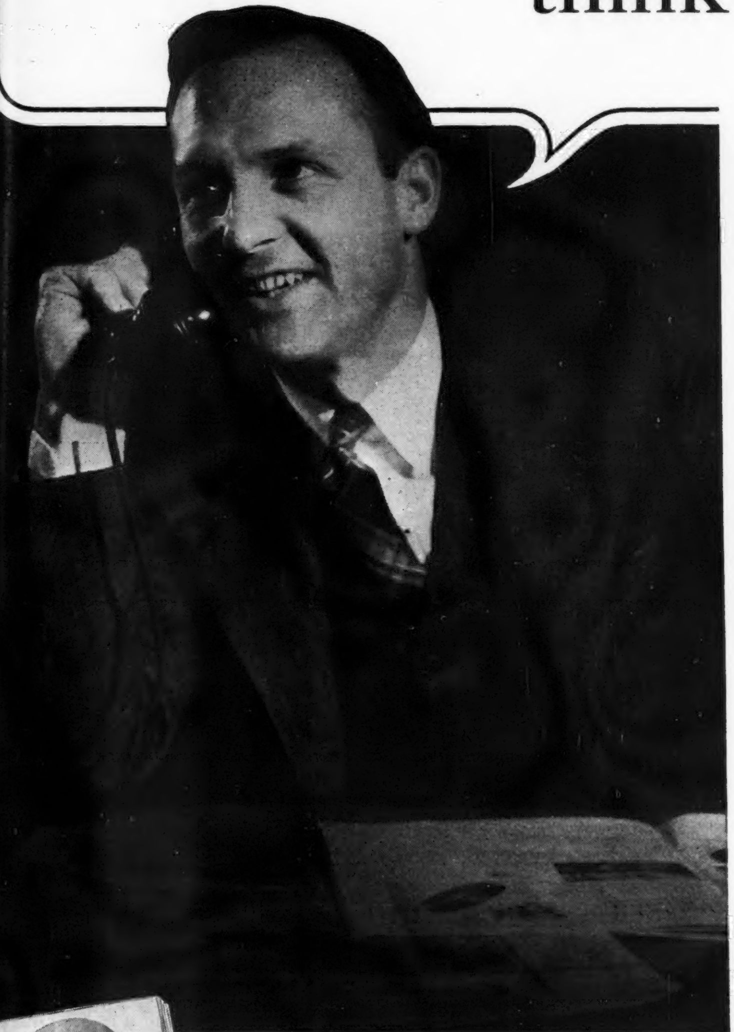
| County | Tractors | County | Tractors | County | Tractors |
|---|---|---|---|---|---|
| | 74 | Madison | | Monterey | 1,607 |
| Choctaw | 87 | | | Napa | |
| Clark | | Marion | 154 | Nevada | |
| Clay | 158 | Marshall | 329 | Orange | |
| Cleburne | 74 | Mobile | 74 | | |
| Coffee | 78 | Monroe | 78 | | |
| Colbert | 143 | Montgomery | 262 | | |
| Conecuh | 33 | Morgan | 378 | | |
| Coosa | 77 | Perry | 131 | | |
| Covington | 87 | Pickens | 226 | | |
| Crenshaw | 52 | Pike | 77 | | |
| Cullman | 198 | Randolph | 121 | | |
| Dale | 34 | Russell | 81 | | |
| Dallas | 205 | St. Clair | 144 | | |
| DeKalb | 240 | Shelby | 219 | | |
| Elmore | 127 | Sumter | 111 | | |
| Escambia | 62 | Talladega | 331 | | |
| Etowah | 322 | Tallapoosa | 110 | | |
| Fayette | 130 | Tuscaloosa | 121 | | |
| Franklin | 197 | Walker | 115 | | |
| Geneva | 122 | Washington | 119 | | |
| Greene | 45 | Wilcox | 81 | | |
| Hale | 202 | Winston | 57 | | |
| Henry | 80 | | 11,005 | | |

| County | Tractors | County | Tractors |
|---|---|---|---|
| Ventura | 2,059 | Yolo | 1,766 |

| County | Tractors | County | Tractors |
|---|---|---|---|
| Appling | 16 | | |
| Atkinson | | Clay | 49 |
| Bacon | 7 | Clayton | 82 |
| Baker | 62 | Clinch | 4 |
| Baldwin | 42 | Cobb | 191 |
| Banks | 111 | Coffee | 47 |

County
Adams
Alamosa
Arapahoe
Archuleta
Baca
Bent
Boulder
Chaffee
Cheyenne
Clear Creek
Conejos
Costilla
Crowley
Custer
Delta
Denver

# "Well, Mr. Jones, here's what I think about Fence:



"IN the first place, good fence is absolutely necessary if you practice balanced farming, including soil conservation, livestock and livestock sanitation.

"But you must realize, of course, that all fence is not equally effective. There are many points to consider in choosing good woven-wire fence.

"What's that? Oh yes—well American seems to be the best known and most widely used, and it has certainly stood the test of time.

"Yes—it's made by responsible people —American Steel & Wire Company and other Subsidiaries of United States Steel Corporation.

"Yes, Mr. Jones, I can tell you the principal features of American Fence. It is strong and springy. It is heavily and properly galvanized to withstand corrosion — and made of copper-bearing U·S·S Long-life, rust-resisting wire.

"I beg your pardon? Oh yes—the stay wires are properly placed, the wraps are long and tight, the wire is full gage.

"You can feel perfectly sure of getting full length, full weight rolls and real value when you buy American Fence. I'm sure you'll be satisfied.

"I have often recommended American Fence and I've never had any reason to regret it."

*Write today for a free copy of our book "Wire and Steel Products for the Farm." Tells what points to consider in choosing fence, posts and gates. How to erect fence properly. Interesting facts on other wire products for the farm, too. Send for it today.*

USS

## AMERICAN FENCE *and* POSTS

*Proven on Thousands of American Farms for More than Forty Years*

AMERICAN STEEL & WIRE COMPANY, *Cleveland, Chicago and New York*

COLUMBIA STEEL COMPANY, *San Francisco*

TENNESSEE COAL, IRON & RAILROAD COMPANY, *Birmingham*

UNITED STATES STEEL

## Washington News Letter

*(Continued from page 477)*

ligerents. It imposes an immediate loss upon American trade as the price of security from ultimate involvement. Critics of the measure point out that (1) there is still no assurance that the United States will not ultimately be involved, and (2) that the price paid is still to be calculated.

Consideration of the second factor involves a balancing between the additional trade that will result from repeal of the arms embargo and the extent to which exports to Europe will be hampered by the requirement that they be entirely transported in foreign shipping. One thing is definite, however, that a serious blow has been dealt to the budding American merchant marine, now barred from the world's busiest trade channel. An immediate reaction to the passage of the bill was the transfer from the United States to Panama registry of a fleet of oil tankers, and the announcement that a number of other such transfers were in contemplation.

## M. L. Nichols in Charge of S.C.S. Research

ANNOUNCEMENT was recently made by Dr. H. H. Bennett, chief of the U. S. Soil Conservation Service, that Dr. Mark L. Nichols, who for the past year has been acting in charge of the research program of the Soil Conservation Service, is assigned to the position to assistant chief of the Service in charge of research, and he will continue administratively and technically in charge of the research program of the Service.

## Personals

*John M. Ferguson and E. L. Barger* furnish information on "Tractor Overheating: Causes and Remedies," in Kansas State College mimeographed Extension Circular 21. Mr. Barger has also reported on his studies of "Tractor Fuels" in Kansas State College Bulletin Vol. XXIII, No. 6.

*John R. Haswell* and *V. S. Peterson,* respectively, professor and assistant professor of agricultural engineering extension, Pennsylvania State College, are joint authors of agricultural extension circular (No. 215), entitled "Electric Wiring for the Farm," published in September of this year by the extension service of that institution.

*Roy E. Hayman,* in charge of rural electrification, Oklahoma Gas & Electric Company, cooperating with the Oklahoma City Chamber of Commerce, has worked out a lease which enables a tenant farmer with two children and less than $300.00 in cash to become a user of $2.70 worth of electricity per month at the end of two years.

*G. E. Henderson,* assistant agricultural engineer, was recently made assistant chief of the division of agricultural engineering of the Tennessee Valley Authority, succeeding J. W. Weaver.

*Frank B. Lanham,* research agricultural engineer, University of Georgia, presented a paper, entitled "Agriculture Has Engineering Problems in Heating and Ventilating," before the fall meeting of the American Society of Heating and Ventilating Engineers held at Atlanta, Georgia, in October.

*P. T. Montfort,* in charge of rural electrification, A. and M. College of Texas, recently held a most successful rural electrification school attended by about 75 utility representatives, REA project supervisors, and county agricultural agents. The procedure of the school was to learn to do by doing and not by listening.

*J. A. Schaller* is in charge of the hay drier project sponsored by the agricultural engineering development division of the Tennessee Valley Authority. Six of the new type hay driers developed in connection with this project have been installed in barns in as many states, namely, Tennessee, Georgia, Alabama, Ohio, Illinois, and Rhode Island.

*H. E. Wichers* is author of "Low Cost Homes," published as Bulletin No. 38 of the Kansas Engineering Experiment Station.

## Necrology

DANIELS SCOATES, professor and head of the agricultural engineering department, Texas A. & M. College, and a past-president of the American Society of Agricultural Engineers, passed away November 14 following a long illness, at the age of 57.

Mr. Scoates was born at Crown Point, Ind., in 1882, earned his bachelor's degree in civil engineering at Iowa State College, and after some professional experience returned there to supplement his training in the field of agricultural engineering. After gaining experience as assistant in agricultural engineering at Montana State College in 1910, he went to Mississippi A. and M. College as professor and head of the agricultural engineering department, and remained there until 1919, when he became head of the agricultural engineering department at Texas A. and M. College. In 1915 Iowa State College conferred upon him the professional degree of agricultural engineer.

Mr. Scoates was a past-president of the American Society of Agricultural Engineers, having served in that capacity during 1918, after having been a member since 1909. He had also served as chairman of the Society's College Division, and on numerous committees.

In his professional field he had made numerous contributions to the farm press, was author or joint author of several texts and laboratory manuals, and was agricultural engineering editor for the McGraw-Hill Book Co. He was also a member of the board of the Texas Hardware Mutual Fire Insurance Company and of the Mercantile Mutual Fire Insurance Company, and secretary of the Texas Hardware and Implement Dealers' Association since 1924. He had recently been named honorary secretary of the latter organization. He was also a member of the Society for the Promotion of Engineering Education, and of the Masonic lodge. He is survived by his widow, Mary Lamb Scoates, a son William, of the Rural Electrification Administration, and two daughters, Mrs. C. E. Long of Houston, and Alice of College Station.

CARL BEHN, vice-president, American Bosch Corporation, passed away November 15, according to notice received from the company. He was 43 years of age and had been elected to membership in the A.S.A.E. during the current year.

From 1923 to 1931 he was sales engineer for the Robert Bosch Magneto Co., and manager of the Detroit branch office of the company. He continued in this position with the United American Bosch Corporation from 1931 to 1935. From 1935 to 1938 he was manager of diesel engine sales for the National Supply Company. Since 1938 he had been in the position occupied at the time of his passing, being in charge of all sales of the American Bosch Corporation.

Mr. Behn was also a member of the Society of Automotive Engineers, American Society of Mechanical Engineers, American Petroleum Institute, and National Aeronautical Association of America.

## Applicants for Membership

**The following is a list of applicants for membership in the American Society of Agricultural Engineers received since the publication of the November issue of AGRICULTURAL ENGINEERING. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.**

*Clarence J. Bush,* junior engineer trainee, Rural Electrification Administration, Washington, D. C. (Mail) 1426 21st St., N.W.

*R. A. Childers,* general manager of sales, Southern States Iron Roofing Co., Savannah, Ga. (Mail) Box 1159.

*J. Robert Dodge,* associate architect, Bureau of Agricultural Chemistry & Engineering, U. S. Department of Agriculture, Washington, D. C. (Mail) 2614 Woodley Place.

*L. G. Duggar,* State TP Engineer, Farm Security Administration, U. S. Department of Agriculture. (Mail) 128 Hall St., Athens, Ga.

*Floyd Evans,* salesman, Slusser McLean Scraper Co., Sidney, Ohio.

*George E. McPhee,* student engineer, Rural Electrification Administration, Washington, D. C. (Mail) 5527 Fourth St., N.W.

*Harry C. Murto,* assistant hydraulic engineer, Soil Conservation Service, U. S. Department of Agriculture, Washington, D.C.

*Norris P. Swanson,* 622 North 15th Street, Clarinda, Iowa.

*Norman C. Teter,* research fellow, agricultural engineering department, Iowa State College, Ames, Iowa.

*John H. Wetzel,* area engineer, Soil Conservation Service, U. S. Department of Agriculture. (Mail) Breneman Bldg., Lancaster, Pa.

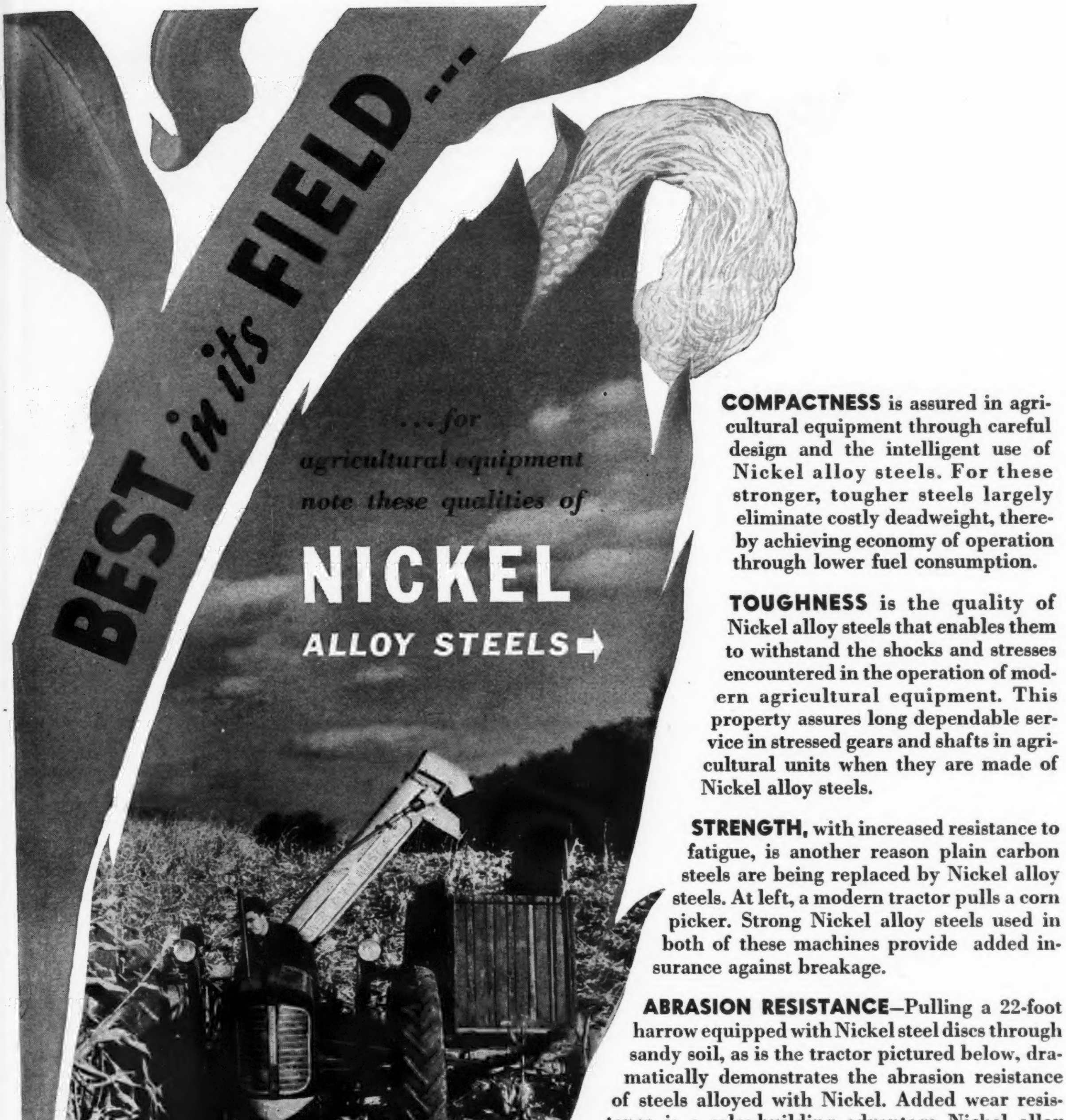
*Charles G. Wurst,* assistant rural rehabilitation supervisor, Farm Security Administration. (Mail) Lumpkin, Ga.

## Student Branches Active

STUDENT branches of the A.S.A.E. which have become active since the beginning of the new school year, by payment of dues to the Society, are as follows:

| | | |
|---|---|---|
| Georgia | 72 | members |
| Minnesota | 15 | " |
| Missouri | 18 | " |
| Nebraska | 24 | " |
| North Carolina | 19 | " |
| Oklahoma | 15 | " |
| South Carolina | 24 | " |
| Saskatchewan | 15 | " |
| Texas | 50 | " |

The student branch at Texas A. & M. College was the first to report its organization completed after the beginning of the school year.




**COMPACTNESS** is assured in agricultural equipment through careful design and the intelligent use of Nickel alloy steels. For these stronger, tougher steels largely eliminate costly deadweight, thereby achieving economy of operation through lower fuel consumption.

**TOUGHNESS** is the quality of Nickel alloy steels that enables them to withstand the shocks and stresses encountered in the operation of modern agricultural equipment. This property assures long dependable service in stressed gears and shafts in agricultural units when they are made of Nickel alloy steels.

**STRENGTH,** with increased resistance to fatigue, is another reason plain carbon steels are being replaced by Nickel alloy steels. At left, a modern tractor pulls a corn picker. Strong Nickel alloy steels used in both of these machines provide added insurance against breakage.

**ABRASION RESISTANCE**—Pulling a 22-foot harrow equipped with Nickel steel discs through sandy soil, as is the tractor pictured below, dramatically demonstrates the abrasion resistance of steels alloyed with Nickel. Added wear resistance is a sales-building advantage Nickel alloy steels offer implement and tractor men.

**THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL ST., NEW YORK, N. Y.**

# Agricultural Engineering Digest

A review of current literature by R. W. TRULLINGER, assistant chief, Office of Experiment Stations, U. S. Department of Agriculture. Copies of publications reviewed may be procured only from the publishers thereof, whose names and addresses may be obtained on request to AGRICULTURAL ENGINEERING, St. Joseph, Michigan

SOIL INVESTIGATIONS BY THE WASHINGTON STATION. (Partly coop. U. S. D. A. et al.) Washington Sta. Bul. 368 (1938), pp. 17-22, 89-91. The following topics are briefly reported upon: Fertility investigations of Washington soils and utilization of fertilizers on representative upland soils in western Washington both by L. C. Wheeting, S. C. Vandecaveye, and L. E. Dunn; the maintenance of organic matter in eastern Washington soils and plant composition as influenced by variation in climate and soil type, both by Vandecaveye, Wheeting, and L. T. Kardos; hardpan formation in the irrigated soils and changes occurring in irrigated soils as a result of irrigation, cropping, and fertilizer treatments, both by Wheeting and Vandecaveye; land classification and soil surveys, by Wheeting; fertility of irrigated soils, by Vandecaveye, Wheeting and H. P. Singleton; maintenance of organic matter in central Washington, by Wheeting, Vandecaveye, and H. D. Jacquot; investigations of the effect of accumulations of arsenical sprays in orchard soils, by Kardos, Vandecaveye, and C. M. Keaton; fertility investigations of greenhouse soils, by Wheeting and Dunn; and legume culture distribution, by Vandecaveye.

From the Soil Conservation Substation brief reports on effect of plant cover on runoff and erosion, movement and balance of soil moisture, cropping practices in relation to erosion control, and tree planting for erosion control are contributed by G. M. Horner, and tillage and cultivation practices for erosion control and terracing studies, by Horner and L. M. Naffziger.

STUDIES ON SOIL STRUCTURE: EFFECT OF PUDDLED SOILS ON PLANT GROWTH, *W. T. McGeorge and J. F. Breazeale.* Arizona Sta. Tech. Bul. 72 (1938), pp. 411-447, figs. 12. Soil structure may be seriously injured by the vibration of heavy farm implements. The structure of a puddled soil can be rebuilt and productivity restored by a dry fallow. The structure will also be improved by applying a dust mulch to the wet puddled soil, and accompanying this there will be an improvement in plant growth and absorption of plant food by plants grown thereon.

Seed will not germinate in a puddled soil unless it is located near a soil crack or other surface where it can obtain air. One of the principal effects of a puddled state is a reduction in the availability of soil moisture, which is much lower than in waterlogged soils. When organic matter is allowed to decompose in puddled soils, toxic substances will be formed which may seriously reduce their productivity, and even after the structure has been rebuilt by a dry fallow the toxic condition will still exist. The availability of phosphate, potassium, calcium, and nitrogen is materially reduced by soil puddling. This is true of these elements when naturally present in the soil as well as those added as commercial fertilizer.

PROBLEM-AREA GROUPS OF LAND IN THE SOUTHERN GREAT PLAINS, *H. H. Finnell.* U. S. Dept. Agr., [Soil Conserv. Serv.], 1939, pp. [1]+40, map 1. For each of the problem-area groups mentioned there are given approximate acreage, description of the physical factors of soils, physiography, and the erosibility of the soils, together with recommended conservation practices, including crop management, land retirement, soil management, water conservation, and other measures appropriate to the individual land type. An appendix shows, in table 1, the acreage, distribution, present use, the principal physical factors, and the degree of erosion in each problem-area group; and in table 2 the recommended land use adjustments and water-conservation measures in each State for all problem-area groups are presented.

THE REFRIGERATING DATA BOOK, I. New York: Amer. Soc. Refrig. Engin., [1939], 4, ed., vol. 1, pp. [9]+527, figs. [292]. This reference book, previously revised at from 2 to 3-yr intervals, has now been divided into two volumes on refrigerating principles and machinery and on applications of refrigeration, respectively. The first volume, here noted, is scheduled for revision each 4 yr from 1939, the second for revision each 4 yr from 1941.

Of this first volume, part 1 takes up principles of refrigeration, basic processes, and data; part 2, refrigerants; part 3, heat flow and insulation; part 4, air conditioning; part 5, properties of foods; part 6, domestic-commercial machinery; part 7, industrial machinery; and part 8, controls and power.

INDUSTRIAL WASTE TREATMENT PROCESSES AND PLANT DESIGN, *E. F. Eldridge.* Mich. Engin. Expt. Sta. Bul. 82 (1938), pp. 103, figs. 31. Part 1 deals generally with industrial waste pollutions. Parts 2 to 11 take up, respectively, beet sugar, milk products, metal treating and plating, canning, meat packing, tannery, textile, laundry, and pulp and paper mill wastes and the effect of industrial wastes in sewage treatment plants.

Insofar as the necessary information has been available, the present bulletin takes up not only the treatment processes but also the structures and equipment required for full-scale practical operation of the process. "In some cases the treatment processes are so . . . defined as to allow exact drawings and dimensions to be given. Even cost data . . . [are] possible in a few cases."

EFFECT OF CLEANING SEED COTTON ON LINT QUALITY AND GINNING EFFICIENCY, *F. L. Gerdes, A. J. Johnson, and C. A. Bennett.* (Coop. Ga. Coastal Plain, La., Miss., and N. C. Expt. Stas., et al.) U. S. Dept. Agr., Tech. Bul. 663 (1939), pp. [2]+64, pls. 9, figs. 13. With hand-picked cottons of wide range of foreign-matter content and staple length, the authors tested a huller front and extractor-feeder with a plain stand, a cylinder cleaner and extractor, and a combination of the cleaner and extractor with a huller stand. The cottons used were practically all below 12 per cent in moisture content and were mostly of 1 1/32-in staple or less. Cleaning tests on hand-picked and snapped cottons with equipment ranging from minimum to elaborate combinations of cleaning and extracting devices with a huller gin were also made.

Bale-weight decreases due to cleaning and extracting were not so great as the weights of foreign matter removed. The "fluffed" cotton from the cleaning machines could be ginned closer, offsetting part of the trash-weight loss by increased weight of the ginned lint.

Improvements of grade as a result of cleaning the seed cotton by the various methods were closely related to foreign matter removed by the cleaning units. Greater enhancements in grade generally resulted with the shorter than with the longer cottons and with the cottons of higher than with those of lower foreign-matter content. The measurements of brilliance of the samples gave relationships generally similar to those shown for grade. When the cleaner and extractor were employed singly or in tandem on the cottons of higher foreign-matter content, the quality of the lint ginned with a loose seed roll was increased by an average of one-half of a grade with the shorter and almost one-third of a grade with the longer cottons. The beneficial effects of these units were less with the tight than with the loose seed roll. When cleaning the cotton of low foreign-matter content, changes in grade for the longer staple cotton were negligible, but for the shorter staple cottons the set-ups with the extractor showed some small enhancements. For the third series of tests the improvements from cleaning for the snapped cottons were almost three times those for the hand-picked cottons and increased with the additional cleaners and extractors from 0.5 of a grade with the six-cylinder cleaner set-up to 1.6 grades with the set-up having three cleaners and two extractors. Although the cleaners and extractors greatly improved the grade of lint ginned from the snapped cottons, the most elaborate combination gave an average grade still about one-third of a grade lower than the average grade of the lint ginned from the picked cottons handled by the simple control set-up.

The grade of lint was not affected by increasing or decreasing the speed 100 revolutions per minute from the manufacturer's recommended speed with either the extractor-feeder or the air-line or out-of-air cleaners. The use of air-line and out-of-air cleaners gave similar grade results.

Differences in ginning time between uncleaned and cleaned, picked cotton were generally small except when, in a few instances, the cleaning units so fluffed the cotton that adequate quantities were not fed to the seed-roll box. With the snapped cotton the use of an extractor caused reductions in the ginning time that averaged about 40 per cent. The removal of burs made possible a continuous gin-stand operation. Energy consumption of the gin stand showed only small increases when cleaning the picked cotton but indicated economies of 16 per cent or larger when the snapped cotton had been extracted. *(Continued on page 486)*

# Agricultural Engineering Digest

*(Continued from page 484)*

ELECTRIC MILK REFRIGERATION AT THE FARM, *J. E. Nicholas and R. U. Blasingame.* Pennsylvania Sta. Bul. 375 (1939), pp [2]+38, figs. 29. Detailed air temperature and performance data concerning several milk-can cooling arrangements electrically refrigerated were obtained in the milk houses of four farms in the warmest part of Pennsylvania (highest 24-hr average milk house air temperature 83.4 F).

Milk cools more rapidly and uniformly in farm electric coolers when the bath water is agitated, and agitation of the cooling water should continue for at least 1 hr. The cooling water should be agitated during the cooling of both morning and evening milk. The average temperature of the evening milk after 12 hr of cooling with sufficient water may be as low as 33.1 F and as high as 40.1 F, depending on the amount of refrigeration initially available and the setting of the thermostat. When agitation with sufficient water is employed the average temperature of the morning milk after 1 hr of cooling may be as low as 42.8 F and as high as 49.3, depending on the amount of refrigeration initially available. A can of milk cools more in the first hour than it does in 11 succeeding hours. With sufficient water level but no agitation of the bath the average temperature of milk after 1 hr of cooling was 52.5 F. When the milk in the cans was stirred and the bath water was not the average temperature of the milk was not below 50 F at the end of the first hour even with a large ice bank on the coils at the start. Milk cools more rapidly under the same thermostat limits with a water : milk ratio of 5 than with a ratio of 3, and more rapidly when some ice is on the coil. The ice maintains the bath water at a low temperature during the first hour of cooling when milk transfers the greatest portion of its heat. If the bath water is agitated and the cans have insufficient water for complete submersion of the milk, the portion which is above the water level will cool slowly. When raining, spraying, or sprinkling of the bath at milk height is practiced, with incomplete submersion of the cans, the average milk temperature is below 50 F in the first hour. When a large ice bank is used the water : milk ratio may be small. A pound of ice in melting and warming to 38 F is as effective in cooling milk as 150 lb of water increasing in temperature from 37 to 38 F. Milk cools most rapidly when a large ice bank is used with sufficient water level and the water is agitated. If sufficient water and agitation with or without ice on coil are used the average temperature of the milk is below 50 F in the first hour of cooling.

The evening load will warm on the outside of the cabinet in an 82 to 85 F room temperature approximately as much as it will if it remains in the cabinet during the cooling of the morning load. At the end of an hour the evening load standing unprotected on the floor in the morning in an 82 to 85 F room will average from 1.2 to 5.1 F colder than the morning milk cooled 1 hr.

Performance coefficients were determined under various operating conditions, the lowest value obtained being 2.11 kwhr per degree Fahrenheit per gallon, the highest 3.09. In an appendix it is shown by calculation of thermal relations that some ice on the coils at the beginning of cooling will give the best results. An equation for heat transfer through ice under the conditions of milk cooling equipment is also set up and integrated.

AGRICULTURAL ENGINEERING INVESTIGATIONS BY THE CALIFORNIA STATION, California Sta. [Bien.] Rpt. 1937-38, pp. 81-83, 92-93. Briefly noted under the heading of improving the mechanics of crop production are a nutcracking device whereby walnuts are carried over a circular slotting saw, filled from jets in a guide rib with explosive gas mixture, and dropped through a burner so that the meats fall into a center container within a larger receiver for exploded shell, the percentage of whole or half meats being much greater than in hand cracking; a new seed-bean thresher; development of sugar beet machinery; new citrus dusting equipment; orchard-heating problems (fuel, fueling, and burner studies); blowers for frost protection; precooling truck crops for eastern shipment; poultry house cooling; and electric protection for mountain apiaries.

SNOW RIDGING TO CONSERVE MOISTURE AND DECREASE EROSION, *H. F. McColly and W. H. Farmer.* North Dakota Sta. Bimo. Bul. 1 (1939), No. 4, pp. 32-35, fig. 1. The authors found that the use of snow plows and crowders to build up ridges 18 in high from a 5-in snowfall resulted in holding much snow on the fields, while similar areas not ridged were blown clean of snow after a thaw, freeze, and second drifting fall of snow. With falls of less than 5 in the authors consider that a second ridging may be necessary to build up ridges of a sufficient depth. The best results were obtained by ridging at a temperature high enough to make the snow damp. The ridges should not be more than 8 ft apart if they are to prevent wind removal and on level ground should be made across the prevailing direction of the wind. On rolling ground, however, contour ridging should be practiced. Not only did the ridges hold snow from blowing but the ice strips formed under the ridges helped to prevent draining off of water during thaws.

Equipment suggested included a push plow driven by a large tractor capable of drawing two pull plows offset back of the drawbar. Less elaborate plows can be made in a good farm shop at a cost of about $25, even when all material must be bought new.

Soil temperatures under 6, 12, and 24 in of snow were recorded.

PRINCIPLES OF GULLY EROSION IN THE PIEDMONT OF SOUTH CAROLINA, *H. A. Ireland, C. F. S. Sharpe, and D. H. Eargle.* (Coop. S. C. Expt. Sta.) U. S. Dept. Agr., Tech. Bul. 633 (1939), pp. 143, figs. 96. This bulletin covers a general study of conditions which make the southern Piedmont particularly susceptible to gullying, and an investigation of the causes, mechanics, and rate of gully cutting in twelve representative gullies, largely untreated, in South Carolina, together with less detailed study of a much larger number. The authors find four distinct stages in the development of the deep-caving gully characteristic of the southern Piedmont. "In stage 1, the channel-cutting stage, the gully works downward through the A and B horizons. Cutting in this stage is relatively slow, and this is the time at which protective measures can best be undertaken. Stage 2 begins when the gully penetrates the base of the B horizon and begins cutting in the weak parent material. This stage, characterized by the headward migration of an overfall and plunge pool and by rapid caving of the walls and deepening of the channel, is much the most violent stage of gully growth and is the least favorable for the successful application of control measures. Caving and slumping of the walls and heads alternate with periodic clearing out of the caved material from the gully channel. Additional substages in the gully's growth may occur in the form of periods of headward progression of successive waterfalls or knickpoints, marking renewed channel cutting and deepening of the gully. Stage 2 ends when erosion is retarded because the channel reaches a graded condition under the control of some local base level. Stage 3 is a period of adjustment to the graded channel. Slopes of the gully walls are reduced by weathering, slope-wash, and mass movement; plants are able to get a foothold on the lowered slopes, and vegetation gradually brings about a healing of the gully. Stage 4 is a period of stabilization and is characterized by the slow development and accumulation of new topsoil over the old scarred surface. Rejuvenated cutting brought about by lowering of the base level or an increase in the amount or rate of runoff can at any time cause stage 3 or 4 to revert to stage 2."

Major climatic factors in gully erosion in the Spartanburg area are the intense cold-front rains and tropical hurricanes of late summer and early fall. Deep weathering of the igneous and metamorphic rocks of the Piedmont prepares the way for rapid erosion. Past and present land use, and periods of land abandonment, in particular, have been causes of sheet erosion and gullying.

EROSION AND RELATED LAND USE CONDITIONS ON THE MINOT AREA, NORTH DAKOTA, *N. Holowaychuk and W. C. Boatright.* U. S. Dept. Agr., [Soil Conserv. Serv.], 1938, pp. [1]+37, pls. 3, figs. 6, maps 5. The area here dealt with comprises four counties in northern North Dakota and contains 4,174,080 acres, the most erosible soils being the dune sands and the light-textured Thurman soil series.

No apparent erosion was found on 15.7 per cent of the area, slight erosion on 67.3, moderate on 12.5, severe on 2.8, and very severe erosion on 1.7 per cent. Wind erosion is more serious than water erosion. Most of the serious wind erosion has occurred on the light-textured soils and wind-erosion control practices are most essential, but water-erosion control practices, also necessary, will provide at the same time for moisture conservation. Serious water erosion is found on sloping areas of medium and light-textured soils. Moderate wind and water erosion occurs on medium and heavy-textured soils on level land. Nearly all serious erosion is on cultivated or idle land.

RURAL WATER SUPPLY AND SEWERAGE.—I, EXCRETA DISPOSAL AND SEWERAGE, *E. W. Steel and P. J. A. Zeller.* (Tex. A. and M. Col.) Tex. Engin. Expt. Sta. Bul. 46 (1939), pp. 27, figs. 7. This bulletin consists mainly of a nontechnical discussion of the construction and operation of septic tank systems, including the function of the subsurface irrigation field, the operation of the sewage disposal system, the construction of the tank, the subsurface irrigation field, and cost estimates.

For preventing top flow through the tank, the authors recommend extra heavy cast-iron soil pipe tees at the inlet and outlet on the ground that tile tees are frequently broken and wooden baffles are likely to rot out. *(Continued on page 488)*

# Agricultural Engineering Digest

*(Continued from page 486)*

WATER CONTROL INVESTIGATIONS BY THE FLORIDA STATION, *B. S. Clayton and J. R. Neller.* (Coop. U. S. D. A.) Florida Sta. Rpt. 1938, pp. 154-156. Records on cost of pumping were continued, also those on effect of water table depths on crop yields; evaporation and transpiration from sugarcane, saw grass, bare soil, and mulched ground; and subsidence of peat soils. An experiment on the surface irrigation of sugarcane was concluded. A number of new subsidence lines were established and soil samples taken.

ARTIFICIAL DAYLIGHTING FOR COLOR GRADING OF AGRICULTURAL PRODUCTS, *D. Nickerson.* (U.S.D.A.) Jour. Opt. Soc. Amer., 29 (1939), No. 1, pp. 1-9, figs. 5. Cotton grading was found, from a study of the demands of experienced classers, to require diffuse, nearly uniform illumination over a wide working area; color matching that of slightly overcast north sky; and an intensity of from 60 to 80 footcandles in the horizontal plane in which the work is to be done. There was little advantage in an increase of more than 100 footcandles, and it was found best to avoid intensities higher than about 150 to 200 footcandles.

In a trial of an experimental set-up of 1,000-watt lamps set about 2 ft apart from center to center, provided with "Daylite" filters, the background above the lamps painted with a zinc oxide paint to absorb infrared radiation as much as possible, and a diffusing skylight of glass ground on one side, it was found that with a filter-and-lamp combination approximately 6800 deg K (Kelvin) in color temperature, the cotton classers could work under it after becoming accustomed to it, but it was too yellowish to be a good substitute for slightly overcast north sky. Changing the Daylite filter from Macbeth 2ACL9, 5.5 mm thick, to Macbeth BDK11 of the same thickness, and using lamps operating at 3000 deg, gave a color temperature of about 7400 deg and illumination "sufficiently like that from the overcast north sky which they [the Cotton Appeal Board] prefer to make the cotton look natural to them."

The result was obtained with lamps rated at 1,000-hr life, 1,000-watt lamps in the outer rows, and 500-watt lamps in the center.

SEWAGE IRRIGATION AS PRACTICED IN THE WESTERN STATES, *W. A. Hutchins.* U. S. Dept. Agr., Tech. Bul. 675 (1939), pp. 60, figs. 14. This bulletin outlines the character of the problem in general terms and takes up in some detail sewage as a source of irrigation water supply, use of water, irrigable lands, crops, safeguards and regulation of public-health authorities, salts in sewage effluents, sewage water rights, and economic feasibility of sewage irrigation. An appendix lists areas in which irrigation with sewage taken directly from outfalls or disposal plants is practiced, and areas using irrigation with sewage diverted from public stream channels.

It is noted that, in general, coarse-textured soils, loose in structure, have proved better suited to sewage irrigation than heavy soils of equivalent fertility, but many tracts irrigated with effluents consist of clay loams and clays. Difficulties with the heavy soils irrigated with effluents have arisen largely from lack of care and judgment in applying the water, rather than from the character of the water. The coarser-textured, lighter soils comprise two-thirds of the soil classes in the areas included in the study. Any change resulting from the use of sewage, so far as reported, was to the effect that the soil structure showed improvement. Crops irrigated with sewage are those commonly grown under irrigation in the locality. Reports generally indicate higher yields with sewage effluents than with other water applied under comparable physical conditions and with equal care.

ARTIFICIAL DRYING OF FARM CROPS IN THE UNITED STATES: A SELECTED BIBLIOGRAPHY, COMPILED BY *D. W. Graf.* U. S. Dept. Agr., Bur. Agr. Engin., 1938, pp. [2]+46. This is a classified reference list containing abstracts of some of the papers noted. The references are grouped under the following headings: Description of machines, general, apparatus, corn, cotton, forage crops, grain, miscellaneous crops (hops, seeds, copra), rice, and sugar beets. An author index is included.

BIBLIOGRAPHY ON HIGHWAY FINANCE, COMPILED BY *L. W. Helvestine.* U. S. Dept. Agr., Bur. Pub. Roads, 1938, pp. [4]+95. In selecting the references the emphasis has been placed chiefly on the theory of highway finance. The principal objective of the list is to present a survey of literature on the various methods of financing employed today and the present trend of public practice. Articles in periodicals which present only the factual and statistical material compiled and published by the Bureau of Public Roads have been omitted from the list.

THE USE OF BITUMINOUS COAL IN THE DEHYDRATION OF ALFALFA AND OTHER FORAGE CROPS, *E. R. Kaiser.* Bituminous Coal Assoc. Inform. Bul. 3 (1939), pp. [1]+22, figs. 2. As advantages of artificial drying, as against sun curing, it is pointed out that artificially dried alfalfa may contain about seven times as much provitamin A as do field-cured plants. "By drying the hay at less than 180 F, while in an atmosphere consisting largely of nitrogen and products of combustion, oxidation is prevented, and the nutrients, including upward of 90 per cent of the carotene, are preserved."

As some of the advantages of bituminous coal as a fuel for the artificial drying of forage crops, the author notes its cheapness, as compared with other fuels on the basis of Btu output, and the facts that bituminous coal, fired by stokers, is so completely burned by proper firing that the hay is not tainted; and that the rate of heat release from the coal-fired furnace can be controlled thermostatically as with oil or gas.

The cost of heating and the saving with bituminous coal can be determined for a given plant by applying a method here given and illustrated. A suggested design of stoker furnace is shown. This may be modified to suit installations of various sizes. The manufacturers and users of dehydrators are urged to consider the savings possible with coal and to equip their machines with furnaces and stokers for use with bituminous coal wherever this coal is readily available and economical.

"The marked saving in nutrients and the improved quality of dehydrated hay as the result of artificial drying are sufficient to warrant consideration of such drying for use at large dairy and hay farms for the production of whole hay."

GEOLOGY AND GROUND-WATER RESOURCES OF THE SNAKE RIVER PLAIN IN SOUTHEASTERN IDAHO, *H. T. Stearns, L. Crandall,* and *W. G. Steward.* U. S. Geol. Survey, Water-Supply Paper 774 (1938), pp. IX+268, pls. 31, figs. 16. The chief purpose of the investigation here recorded was to obtain data regarding the source, movement, and disposal of the ground-water supply of the lava plains that occupy most of the region. By assembling and correlating numerous well records obtained in this and related investigations, tied together by a system of levels, the authors prepared a map of the region showing contours of the water table and the direction of movement of ground water in all parts of the region. This map largely indicates the source and disposal of the water. The total annual ground-water supply of the Snake River Plain is here estimated at 4,000,000 acre-ft., of which only a small part is now utilized for irrigation.

PORTABLE FIELD DRIER, *R. M. Hixon and A. L. Bakke.* (Iowa Expt. Sta., and U. S. D. A. Jour. Amer. Soc. Agron., 31 (1939), No. 3, pp. 268-270, figs. 2. A partly dimensioned longitudinal section drawing, a photograph, and a brief outline of the method of construction describe a set-up 36 by 9.5 by 23 in, exclusive of the 6-volt battery which operates the blower. Air is blown into a hot water jacket compartment, baffled to prevent air channels, and is vented into four drying chambers above the heating chamber, each being baffled to force the hot air into the center of the chamber. The end compartment is water-jacketed to keep the temperature as high as possible. A steam outlet from this jacket leads to a condenser made from an auto heater. The condensate returns to the water bath through a copper pipe large enough to facilitate filling and to serve as blow-off. A rubber tube can be placed over the end of this vent and led to the ground to prevent wetting of the samples by escaping water. The water bath is heated with a portable gasoline camping stove.

GROUND-WATER RESOURCES OF THE HOLBROOK REGION, ARIZONA, *M. A. Harrell and E. B. Eckel.* U. S. Geol. Survey, Water-Supply Paper 836-B (1939), pp. IV+19-105, pls. 10, fig. 1. The Holbrook region includes most of the drainage area of the Little Colorado River in Arizona, exclusive of the Navajo country.

Semiarid conditions prevail except in the mountainous areas to the south. Dry farming has been unsuccessful. Irrigation is practiced to a very slight extent, its chief restrictions being the lack of water of proper quality and quantity. Cattle and sheep grazing have been conducted successfully and are the chief industries. Sufficient well-water supplies may be developed for present herds, but the region as a whole seems not adapted to further expansion of the grazing industry under present conditions of vegetative cover and its use.

The total dissolved solids in the waters range from 80 to 6,197 p. p. m. Waters from recent alluvial materials, the Moenkopi formation, and the Chinle formation are commonly high in dissolved mineral matter. The best waters come in large part from the base of the lava flows or of the Tertiary sands and from the Coconino sandstone.

*(Continued on page 490)*

## Agricultural Engineering Digest

*(Continued from page 488)*

CEREAL NURSERY SEEDERS, *H. M. Beachell.* (U. S. D. A. and Tex. Expt. Sta.) Jour. Amer. Soc. Agron., 31 (1939), No. 3, pp. 265-268, figs. 7. The author describes a seeder adjustable for uniform seeding, with test weights varying from 35 to 52 lb per bushel when sowing 90 lb per acre in rows spaced 1 ft apart. Provision is made for calibration and marking to permit quick and accurate setting.

The author also describes a spacing seeder which consists of small sheet metal cups 7/8 by 3/4 in and 1/2 in deep attached to each link of a No. 25 cast drive chain. The cup was made from 28-gage sheet metal cut according to a dimensioned diagram. The speed of the chain to which the cups are attached is so regulated that a seed placed in each cup is dropped every 4 in. A single seed is dropped in each cup by hand, and any extra seeds dropped accidentally in a cup are removed with forceps. It was found that two men, one filling the cups and the other pushing the seeder, can sow approximately 450 rod rows in a 9-hr day. With two men filling the cups and a third pushing the seeder, as many as 560 rows were seeded in 9 hr.

In addition to the construction shown in the diagram of the cup for the spacing seeder, some details of each of these seeders are shown in photographs.

METHODS AND MACHINERY FOR HARVESTING SOYBEANS, *J. W. Sjogren.* Virginia Sta. Bul. 319 (1939), pp. 10, fig. 1. The beater harvester, binder and mower, and combine harvesting methods were compared with reference to cost and efficiency.

The beater harvester, though adapted to small acreages and to harvesting soybeans planted between corn rows, caused losses of beans ranging from 20 per cent under favorable conditions up to 60 per cent. The 3-yr average loss for all tests and under the various conditions of the tests was 43 per cent. As means for reducing the losses in this method of harvesting, the author suggests planting a variety with erect growth habits, ridging the rows slightly at the last cultivation, and allowing hogs to pick up the wasted seed after the harvester. The cost of harvesting soybeans with the beater harvester is about $2.11 per acre, not including the value of the wasted seed. The binder and mower method of harvesting is used when the soybeans are planted broadcast or with a drill. The ordinary grain thresher can be adjusted to thresh soybeans without excessive cracking or splitting. The speed of the cylinder should be reduced, while the speed of the grain cleaner and the straw rack should be maintained at the regular speed recommended for grain. Special soybean attachments for adjusting grain separators are extensively used. Harvesting losses with the binder and thresher were 24.7 per cent of the total yield. Farmers estimated losses of from 15 to 35 per cent by the binder and mower method. The total cost was $9.38 per acre, high compared with costs in other states. The combine is used extensively for soybeans planted in rows as well as drilled. The introduction of the small combine has increased its use for soybeans in Virginia. The average harvesting losses of the combine were 12.37 per cent of the total yield. The combine was found to require the same type of adjustments as the grain thresher to thresh soybeans satisfactorily. Special equipment for threshing soybeans can be obtained for the combine. The cost of the small combine ranges from $500 to $900, depending on the width of cut and on the special equipment desired.

STRIP CROPPING IN SOUTHWESTERN PENNSYLVANIA, *D. H. Walter.* (Coop. U. S. D. A.) Pennsylvania Sta., Jour. Ser. Paper 783 (1937), pp. 12. This report is based upon 19 farms where strip cropping has been practiced for from 5 to 20 yr. Of these, 16 had all rotation land strip cropped. Strip cropping was started by 16 of the 19 farmers primarily to control erosion. Nine farmers claimed they started the practice without any outside knowledge or influence, 5 had the idea from neighbors, and 3 from reading. Slope was thought by the operators to be the most important factor in determining whether a field should be strip cropped. Degree of slope and convenience in size of fields were the two important factors determining width of strips. The average width of 96 strips on the farms surveyed was 139 ft, and the average slope 16.4 per cent. These strips were found to average 4 per cent off contour. Only one farmer used any type of instrument to lay out strips. There was a tendency to have less clean tilled crops on the steeper slopes.

In general, the operators thought less power and time were required in working fields under their system of strip cropping. Yields were estimated by operators to be higher now than 10 or 15 yr ago, primarily because of lime, manure, and erosion control. Gully control was reported by the farm operators to be the most important accomplishment of strip cropping. Sod waterways were found on 9 farms, but were fully adequate to control erosion on only 3. *(Continued on page 492)*

# Agricultural Engineering Digest

*(Continued from page 490)*

EFFECT OF STEAMING ON THE STRENGTH OF SOUTHERN YELLOW PINE, *S. J. Buckman and L. W. Rees.* (Univ. Minn.) Amer. Wood-Preservers' Assoc. Proc., 34 (1938), pp. 264-296, figs. 4. This study was made on specimens of shortleaf and of slash pines. The trees were from Forrest County, Miss. Comparable groups of clear unseasoned sapwood specimens obtained from five different trees, each specimen being cut 1 by 1 by 34 in, were steamed for periods of time ranging from 3 to 18 hr and at temperatures ranging from 214 to 260 F. The samples for strength tests were sawed from these specimens after they were steamed. The percentage loss in strength for each steaming period was based on control specimens, not steamed.

The data showed considerable loss in all of the strength properties investigated even at the lower temperatures and for the shorter steaming periods, except in maximum shearing strength parallel to the grain, where the loss appeared too small. The strength properties most affected by the least severe steaming were the fiber stress at the proportional limit in the static bending and compression tests. The losses due to steaming for 18 hr at a temperature of 260 F varied from 18.4 per cent for modulus of elasticity to 56.5 per cent for stress at the proportional limit in compression parallel to the grain. It was found that there was a recovery of one-fourth to one-half of the loss in strength due to steaming when specimens were tested at a moisture content of 12 per cent, as compared with the strength of unseasoned specimens. The largest recoveries occurred in those specimens which had been least severely steamed. These recoveries, however, were not permanent and were found to depend upon the moisture content of the wood at the time it was tested. The data were used to show that the reduction in the strength of a 20-in pole steamed for 18 hr is about 31 per cent, while the strength of a 58-in pole steamed for 4 hr is reduced about 5 per cent. Because of this decrease in strength due to steaming, it was recommended that southern yellow pine poles be air-dried prior to preservative treatment.

## EMPLOYMENT BULLETIN

**The American Society of Agricultural Engineers conducts an employment service especially for the benefit of its members. Only Society members in good standing may insert notices under "Positions Wanted," or apply for positions under "Positions Open." Both non-members and members seeking to fill positions, for which ASAE members are qualified, are privileged to insert notices under "Positions Open," and to be referred to members listed under "Positions Wanted." Any notice in this bulletin will be inserted once and will thereafter be discontinued, unless additional insertions are requested. There is no charge for notices published in this bulletin. Requests for insertions should be addressed to ASAE, St. Joseph, Michigan.**

### POSITIONS OPEN

ASSISTANT AGRICULTURAL ENGINEER with farm experience and good basic engineering and agricultural training wanted for work with missionary college in India. Young, adaptable man preferred. Must have missionary purpose as well as technical training. Minimum technical qualification is bachelor of science degree in agricultural engineering. Master's degree highly desirable. Appointee without advanced degree must expect to get it during first furlough. General interest in all phases of agricultural engineering preferred to high degree of specialization. Duties mainly teaching. Ability to cooperate with other members of staff, and to use English language correctly is important. Interested persons should apply to the Candidate Department, Board of Foreign Missions, 156 Fifth Ave., New York City.

### POSITIONS WANTED

AGRICULTURAL ENGINEER, with B. S. degree from Rutgers University (1937) and M. S. degree from Virginia Polytechnic Institute (1939) possessing diversified agricultural engineering training, with a major in farm power and machinery, desires employment in institutional instructional, research, or extension work, or with commercial concern, in any branch of agricultural engineering. Age 24. Health excellent—no defects. Single. Rural background. Complete credentials furnished upon request. Best of references. PW-311

AGRICULTURAL ENGINEER, 1939 graduate with a bachelor's degree and a farm background, desires a position in any field of agricultural engineering. Has had summer experience with SCS and AAA. Age 20. Single. PW-312

AGRICULTURAL ENGINEER, with farm background, B.S. degree in electrical engineering, M. S. in Agriculture, professional degree of agricultural engineering, certified agricultural engineer with $5\frac{1}{2}$ years' experience in engineering and rural electrical utilization with agricultural extension service and two utility companies, desires position in agricultural engineering research, teaching, or extension work. Age 29, married. PW-313

EL-
mer.
. 4.
nes.
s of
rent
for
ang-
wed
loss
peci-

rop-
the
ngth
The
were
and
at a
s of
t in
as a
e to
f 12
nens.
been
rma-
f the
that
hr is
l for
e in
ellow

**ploy-**
**ociety**
**ted,"**
**s and**
**lified,**
**be re-**
**n this**
**unless**
**pub-**
**ed to**

xperi-
anted
man
train-
legree
rable.
uring
engi-
nainly
nd to
ersons
oreign

Rut-
echnic
eering
s em-
work,
engi-
Rural
Best

bache-
field
n SCS

B.S.
sional
gineer
ctrical
com-
each-